

**The Impact of Official Development Assistance on Agricultural
Growth and Agricultural Imports in Developing Countries**

by

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A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Science

Auburn, Alabama
May 08, 2017

Keywords: foreign aid, ODA, agricultural growth,
agricultural imports, saving, consumption

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Abstract

The economies of developing countries revolve primarily around agriculture. For the developing countries to catch up with the industrialized world, the starting point is to invest in agriculture. Due to capital constraints, it takes longer for the developing countries to reach the development stage without foreign assistance. Thus, rich countries help the poor ones and the assistance come in the form of foreign aid—mostly official development assistance. However, farm organizations in donor countries are concerned about foreign aid to agriculture sector in developing countries. They believe agricultural output growth in developing countries harms donor countries' farm exports.

To evaluate the claim, an equilibrium displacement type model (EDM) is developed to explore the links between agricultural growth, agricultural imports, savings, and official development assistance (ODA). Parameters of the model are estimated using a time-series cross-section data set for 46 developing countries. A fixed effect estimator is used to control for unobserved heterogeneity across the countries, and instrumental variables are used to control for endogeneity bias. Estimation results suggest a positive relationship between ODA and agricultural imports. Breaking down ODA by sector level, results suggest ODA directed at the agricultural sector considerably increases agricultural imports. However, adding remittance into the agricultural imports equation significantly reduced the effect of agricultural ODA on agricultural imports.

Acknowledgments

I would like to thank my major professor, Dr. Henry Kinnucan, for his time and energy. I am forever grateful to him and appreciate everything he has done for me. I would also like to thank Dr. Emir Malikov for his invaluable comments, and for serving in my thesis committee. His constant support during this time has been vital. A Thanks also goes out to Dr. Valentina Hartarska for serving as my advisory committee member, and for everything she did to help me. I am also grateful to Dr. Patricia Duffy, Dr. Deacue Fields, and all other staff and students here in the Department of Agricultural Economics at Auburn University for their assistance.

I truly appreciate the financial support from the Fulbright program during my time here in the United States.

Finally, I would like to thank my family, particularly my parents and my beloved wife, for their unconditional love, constant support, and encouragement during this challenging journey of my life.

Table of Contents

Title	Page
Abstract.....	ii
Acknowledgments	iii
Table of Contents.....	iv
List of Tables	vi
List of Figures.....	vii
List of Acronyms	viii
Chapter 1. Introduction	1
1.1. Overview.....	1
1.2. Motivation for Thesis and Research Question.....	6
1.3. Roadmap	7
Chapter 2. Background	8
2.1. Foreign Aid: Definition.....	8
2.2. Foreign Aid and Economic Growth	9
2.3. The Big Push.....	14
2.4. Foreign Aid and Saving	16
2.5. Foreign Aid and Consumption.....	18
2.6. The World Bank and the Development Theories.....	24
2.7. U.S. Aid and the Marshall Plan.....	26
2.8. Who Gives Foreign Aid to Whom and Why?.....	28
2.9. Aid Pessimism	31
2.10. Summary of Previous Work.....	35
Chapter 3. Methodology and Data	41
3.1. Part 1: Deterministic Simulation.....	41
3.1.1. Reduced Form	44
3.1.2. Results.....	45

3.2. Part 2: Econometric Analysis.....	47
3.2.1. Model	48
3.2.2. Data	51
3.2.3. Results.....	53
3.2.3.1. Agricultural Growth Equation.....	53
3.2.3.2. Savings Equation.....	54
3.2.3.3. ODA Equation.....	55
3.2.3.4. Agricultural Imports Equation	56
Chapter 4. Conclusion and Policy Implications.....	58
4.1. Thesis Summary.....	58
4.2. Policy Implications	60
4.3. Limitations and Ideas for Further Research	63
References.....	64
Appendices.....	67
Appendix I	67
Appendix II	69
Appendix III.....	71
Appendix IV.....	72
Appendix V	73
Appendix VI.....	74

List of Tables

<u>Table</u>	<u>Page</u>
Table 1. Top 10 aid recipient/ donor countries in 2014	29
Table 2. Definition and baseline values of parameters	44
Table 3. Partial effect vs. Total effect of exogenous variables on endogenous variables.....	45
Table 4. Results of OLS and 2SLS estimation of agricultural growth, savings, ODA, and agricultural imports for 46 developing countries from 2002-2014.	53
Table 5. Agricultural Imports with remittance.....	57

List of Figures

<u>Figure</u>	<u>Page</u>
Figure 1. Agriculture, value added (% of GDP) vs cereal yield (1000 kg per hectare) (world average).....	3
Figure 2. Employment in agriculture as a share of total employment	4
Figure 3. The basic mechanics of capital accumulation	11
Figure 4. Poverty trap	12
Figure 5. The role of ODA in breaking the poverty trap	13
Figure 6. Illustration of a Poverty trap	14
Figure 7. ODA flow, consumption and capital	21
Figure 8. Technical assistance flow, consumption and capital	23
Figure 9. ODA by income level	30
Figure 10. ODA by Sectors in 2014.....	31

List of Acronyms

2SLS	Two Stage Least Squares
ADB	African Development Bank
DAC	Development Assistance Committee
ECIP	European Center for International Political Economy
EU	European Union
FDI	Foreign Direct Investment
FPI	Foreign Private Investment
GDP	Gross Domestic Product
GFI	Global Financial Integrity
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
LDC	Least Developed Countries
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
ToT	Terms of Trade
UNDP	United Nations Development Program
UNFAO	United Nations Food & Agriculture Organization
WDI	World Development Indicators

Chapter 1. Introduction

1.1. Overview

Majority of the poor, in terms of share and number of poor, live in rural areas where the main source of income is agriculture (Meijerink & Roza, 2007). Agriculture is an important industry of major proportions in virtually all underdeveloped countries, contributing to some 40 to 60 per cent of the national income and from 50 to 80 per cent of the labor force in production (Johnson & Mellor, 1961; Bachman, 1965; World Development Report, 2008). To reduce poverty, it is important to focus on agriculture to encourage rural economic growth. Agriculture contributes to the economic growth by supplying food and products, employing workers, and creating markets for both agricultural products and input supplies. An example from history is the case of Green Revolution. In the 1960s, when Asian population was growing in an unprecedented rate, experts were concerned about a widespread famine in Asia. In response, agricultural research was funded by governments and private foundations to improve seeds and farming techniques. These investments together with good policies led to Green Revolution—to which Asia in particular and the world at large owe their current stability. Therefore, among other basic drivers of growth, growth of agriculture is very important for the developing countries to catch up with the rest of the development caravan by entering the industrialization stage. Furthermore, a study finds that each additional dollar income from agriculture adds \$2.5 on average to the overall economy (Pinstrup-Andersen et al., 1995). The effect of that dollar ripples through the economy as it changes hands, through increasing productivity in other sectors as well.

Alain and Elisabeth (1988) explain that agricultural growth stimulates industrial growth by (1) providing the scarce labor force for industry; (2) lowering food prices which in turn will

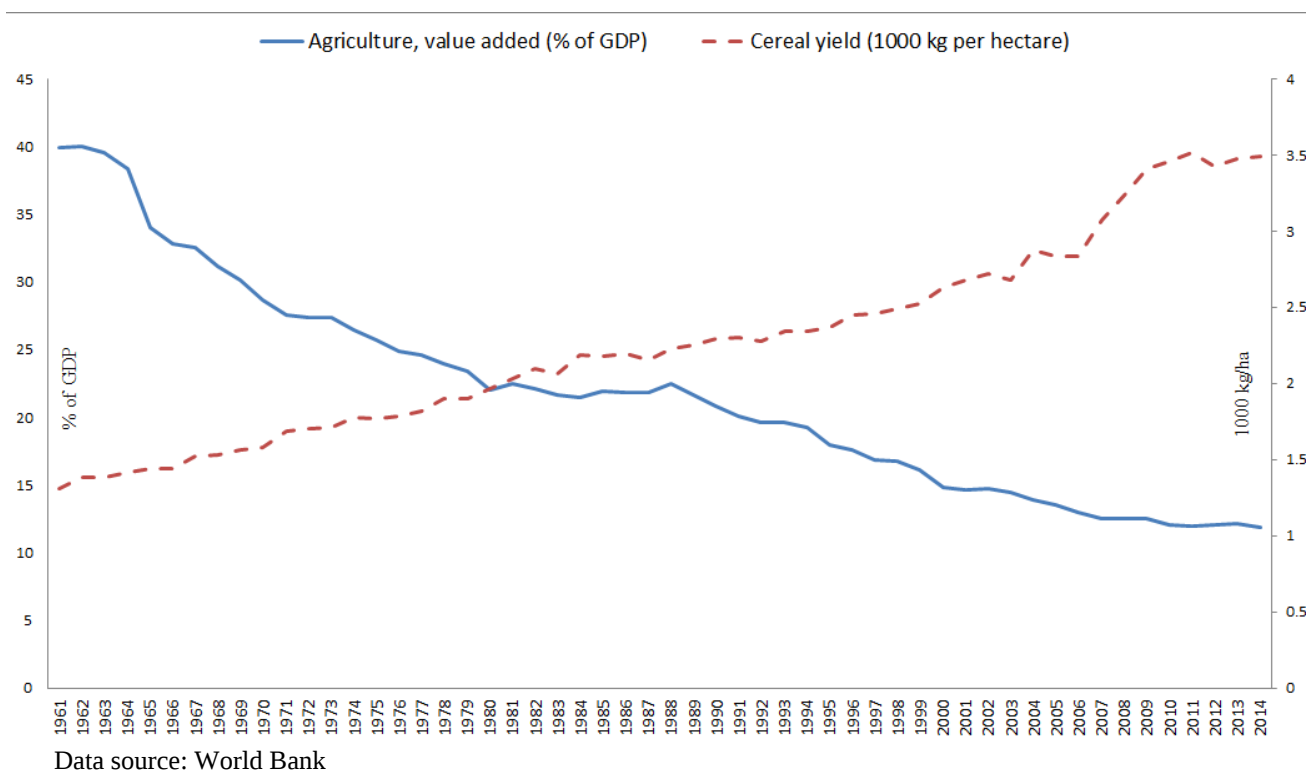
affect nominal wages and the price of raw materials; (3) import substitution and increased exports and, hence, acquiring foreign exchanges; (4) providing market for industrial products; and (5) contributing in investment in the rest of the economy by taxation and other means¹. Furthermore, Gollin et al. (2002) argue that growth in agricultural productivity is central to development as low agricultural productivity can substantially delay industrialization. However, agricultural growth is highly dependent on the appropriate “balance” between agriculture and other sectors in terms of direct government investment, public budget allocation and the burden of taxation levied on different sectors (Johnston & Mellor, 1961).

Figure 1 shows that the contribution of agriculture to economic growth, however, is paradoxical. Such that the share of agriculture in economic growth is decreasing (structural transformation) while the productivity of agriculture, for instance the yield of cereals, is increasing (Meijerink & Roza, 2007). However, for countries with comparative advantage in exporting agriculture products, the relative decline in agriculture will not proceed rapidly, but will take place eventually if they achieve a sizable increase in per capita incomes (Johnson & Mellor, 1961). The share of agriculture in employment experiences the same trend (figure 2), i.e., as the productivity of agriculture grows, labor moves out of the sector (Gollin, 2002).

The reasons for the declining share of agriculture in economic growth (structural transformation) can be the income elasticity of demand for food that is less than 1 (and declining) and the possibility of a substantial expansion of agricultural production with a constant or declining farm labor force.

¹ The authors cite Jorgenson (1969), Lele & Mellor (1981), and Lele & Mellor (1984)

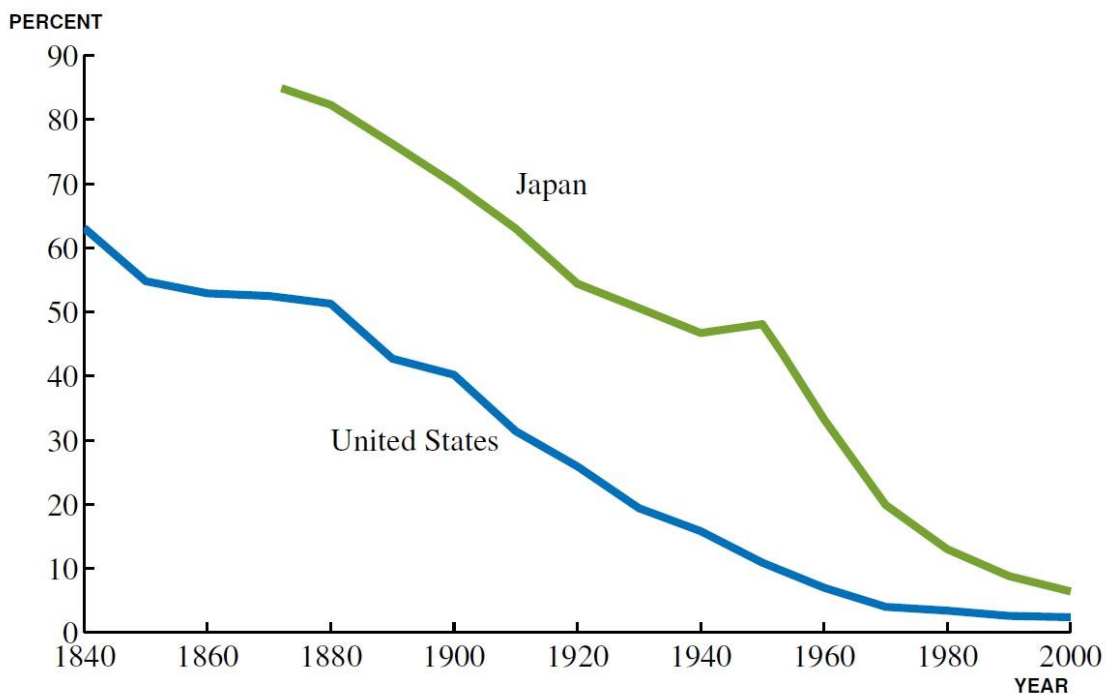
Figure 1. Agriculture, value added (% of GDP) vs cereal yield (1000 kg per hectare) (world average)



The contribution of agricultural trade in development, on the other hand, is also noteworthy. Unlike in the past, agriculture supply is no longer shaped by domestic demand per se, but by international trade as well. The high speed of globalization affects agricultural sector as well which requires to be adjusted in terms of globalization and liberalization, i.e., agriculture sector needs to adapt to the increasing integration of economies around the world and governments in developing countries should also implement policies that facilitate the privatization, domestic price reforms, and a move towards open economies (Meijerink and Roza, 2007). Liberalization and globalization lead to the flow of foreign direct investments (FDI), increased productivity, and also increased share of high value agricultural products—mainly fish, fishery products, and fruits and vegetables—in international agricultural trade which in turn leads to a rise in exports and agriculture development. Aksoy (2005) argues that agriculture trade for developing countries now needs to focus on high value agriculture products, such as seafood,

fruits, vegetables, cut flowers and other processed products. Likewise, globalization can also help farmers in developing countries to have easy access to high quality inputs—improved varieties of seed, fertilizers, machinery, skills and production know-how.

Figure 2. Employment in agriculture as a share of total employment



Source: Herrendorf, Rogerson and Valentinyi (2014).

However, with rapid global technical change and increasingly integrated markets, prices fall faster than yields rise. So, rural incomes fall despite increased productivity if they are net producers. Besides, healthy young people move from rural areas to urban areas as a result of rural and urban integration, leaving behind the old and the sick that are dependent. This has resulted in an increased sophistication of the agriculture value chain and markets which excludes traditional small-holders, who are poorly equipped to meet the demanding product specification and timeliness of delivery required by expanding supermarkets.

The disappointment with agriculture led many donor organizations to turn away from agriculture, looking instead to areas that would increase the well-being of poor people, such as health and education. The organizations that still focus on agriculture were put under pressure to focus more on reducing poverty, besides increasing agricultural productivity.

Nevertheless, there seems to be a renewed interest in agriculture by the turn of the new century. Reports published by the World Bank and other policy documents (e.g. The 2008 World Development Report of the World Bank) states that growth in agriculture is the main driver towards reducing poverty in developing world. Therefore, developed economies are increasingly financing the less developed countries through foreign assistance to help them climb the first step of the development ladder.

Although little attention has been paid to explore the links between foreign aid and agricultural growth, there are different views on the impact of foreign aid on aggregate economic growth, savings, and trade. Some believe that with wise policies foreign aid can increase growth in developing countries, if managed properly (Papanek, 1973; Burnside & Dollar, 1997; Sachs, 2006). While some others think otherwise. They believe that foreign aid reduces savings and investments, increases corruption and consumption, and causes *Dutch Disease* in developing countries (Moyo, 2009; Griffin & Enos, 1970; Easterly, 2006). Furthermore, farmer organizations in donor countries are concerned about foreign aid hurting their farm exports by increasing agricultural products in developing countries. This thesis discusses all the above concerns.

1.2. Motivation for Thesis and Research Question

As discussed before, for the less developed countries to catch up with the industrialized world, besides exports, savings and investments, agriculture is the main driver of growth. Since a high portion of the population in developing countries is involved in agriculture, investing in this sector is considered as a first step towards industrialization. Improvements in agricultural sector will also help in closing the import-export gap by increasing agricultural exports.

However, most of the less developed countries face a budget deficiency and foreign exchange limitation, the savings limitation, and skill limitation (capital absorptive capacity) (Chenery and Strout, 1966). This means that increasing investments in agriculture will divert resources from other important sectors, e.g., health, security, etc. Therefore, to fill this gap, developing countries need further assistance from the rich countries and other multilateral organizations. Foreign assistance, including technical aid in agriculture, from industrialized countries will help increase the capacity of the less developed economies to start climbing the first step of the development ladder (Mikesell, 1982; Bachman, 1965).

Nevertheless, in the past, farm organizations in industrialized countries were concerned about the use of foreign aid funds in improving agriculture in less developed countries (Janvry & Sadoulet, 1988; Kherallah et al., 1994). They argued that funding agricultural research in less developed countries will cause an increase in agricultural output in LDC and hence reduce agricultural exports of industrialized countries. In response to the farm organizations, many economists concluded that improving agricultural productivity in less developed countries increase income in these countries and the rising income will increase demand for imports from

industrialized countries (Bachman, 1965²; Kherallah et al., 1994). Furthermore, industrialized countries have a strong comparative-advantage position in most of the agricultural products demanded by less developed countries, i.e., less developed countries are unable to compete with the developed countries (Bachman, 1965). Therefore, agricultural assistance to less developed countries is recommended.

Several studies have established the link between income growth and food imports (Bachman and Paulino, 1979; Kellogg, Kodl and Gracia, 1987; Houk, 1988; de Janvry and Sadoulet, 1988). Little attention has been paid to the link between foreign assistance and agricultural growth (Norton, Ortiz and Pardey, 1992). The purpose of this work is to explore the link between ODA and domestic market creation for foreign agricultural commodities. The relationship of official development assistance (ODA) to the main drivers of growth in developing countries—agricultural growth, savings, and foreign direct investment—is also of interest to us. Although these links are evaluated by Kherallah et al. (1994), this work will extend the time frame to see if the results still hold true. Furthermore, the relationship between agricultural growth and agricultural ODA will also be examined in this study.

1.3. Roadmap

This thesis is organized in four chapters. Following this introduction is a detailed background review of foreign aid and theories presented by development economists to justify foreign aid. An econometric analysis along with deterministic simulation is presented in third chapter. Chapter four concludes the thesis with policy implications.

² Bachman cites Mackie (1965)

Chapter 2. Background

2.1. Foreign Aid: Definition

Although foreign assistance (foreign aid) and official development assistance (ODA) have different definitions, in our discussion in this thesis they are used as synonyms. For simulation and empirical analysis (chapter 3), I use ODA.

Griffin and Enos (1970) put the definition of foreign assistance in a sentence as “[m]any changes will take place, and must take place, for an underdeveloped country steadily to increase the material well-being of its citizens. These changes can be encouraged or hindered by groups within the country or without; when the encouragement or hindrance comes from without, it is commonly called foreign assistance or foreign aid.” Mikesell (1970) defines official development assistance as “...concessionary aid³ from governmental and multilateral public institutions is frequently referred to as official development assistance (ODA).” A significant characteristic of concessionary aid is that in almost all cases it influences the policies of the recipient country and in many cases it is combined with technical assistance (Mikesell, 1970). World Bank gives a precise definition of ODA as following “[n]et Official Development Assistance (ODA) consists of disbursements of loans made on concessional terms (net of repayments of principal) and grants by official agencies of the members of the Development Assistance Committee (DAC), by multilateral institutions, and by non-DAC countries to promote economic development and welfare in countries and territories in the DAC list of ODA

³ Mikesell defines concessionary aid as “[a]ny capital transfer interest and repayment terms of which are less than those available to the recipient in the private market and is provided principally for noncommercial objective.”

recipients. It includes loans with a grant element of at least 25 percent (calculated at a rate of discount of 10 percent).⁴”

The policies of donor countries and other multilateral agencies have been largely influenced by thoughts of development economists. To understand and analyze foreign aid, it is important to look back and review the theoretical approaches to development by economists.

2.2. Foreign Aid and Economic Growth

Chenery and Strout (1966) believe that most of the underdeveloped countries depend on external resources, inflow of skilled manpower and transfer of technical skills to increase their per capita income. They also point out private investment as a key contributor to the recipient country’s development.

For a country to transform from a stagnant economic growth to a sustained growth, some principal changes have to take place that characterize this transformation. These changes include but not limited to an increase in human skills, a rise in the level of investment and savings, the adoption of more productive technology, a substantial change in the composition of output and employment and the development of new institutions. For a country to successfully transform its economy without external resources must simultaneously provide and allocate for all of the requirements of accelerated growth from its own resources. A failure in meeting any of these requirements, e.g., increase in skills, domestic savings, and exports earnings as well as an allocation of these increased resources in such a way to satisfy the changing demands resulting from rising levels of income, will result in frustration of the attempt to increase output. Thus the inflow of external resources into developing countries has become virtually a separate factor of

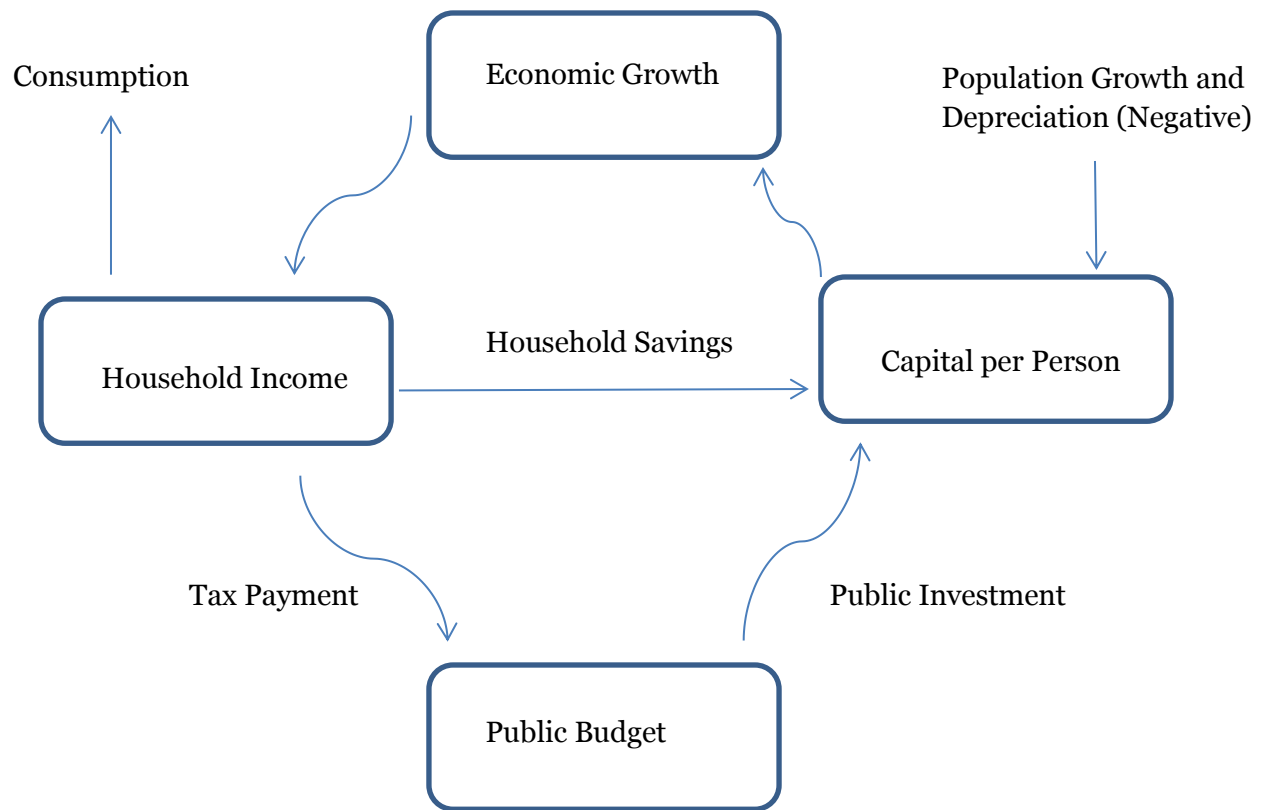
⁴ World Bank, databank

production, whose productivity and allocation is a challenge for development economists. Foreign assistance can be used to temporarily relax some of the potential bottlenecks—of skills, savings, or foreign exchange—for which current payment is not required. More efficient use can then be made of other resources.

Griffin (1978) uses the simple Harrod growth model, $g = sk$, to show the link between growth, savings, and output-capital ratio. Where ‘ g ’ is the proportional rate of growth of national income, ‘ s ’ is the proportion of national income saved and invested, and ‘ k ’ is the incremental output capital ratio. If a country receives aid ‘ a ’ then the equation takes the form of $g = (s + a)k$. Based on this model an inflow of foreign aid will have two effects: it will lead to higher rate of accumulation through supplement of domestic savings; and second, it will raise the proportion of income saved as a result of raises in income per capita. Thus, foreign aid will have a positive effect on economic growth given that savings are moderately sensitive to capital imports.

Sachs (2006) discusses the process in which official development assistance and foreign help can break the poverty trap. In his book, *The End of Poverty*, Sachs first discusses the basic mechanics of capital accumulation, savings, and growth (figure 3). Starting from the left hand side of figure 3, we can see a typical household which divides its income into three parts—basic consumption, savings, and paying taxes. Government uses the budget for current spending and public investment. The capital stock in the economy is raised by household savings and public investments. Worth mentioning that capital stock is also negatively affected by population growth and depreciation. An increasing capital stock leads to economic growth which, in turn, affects household income and the cycle repeats.

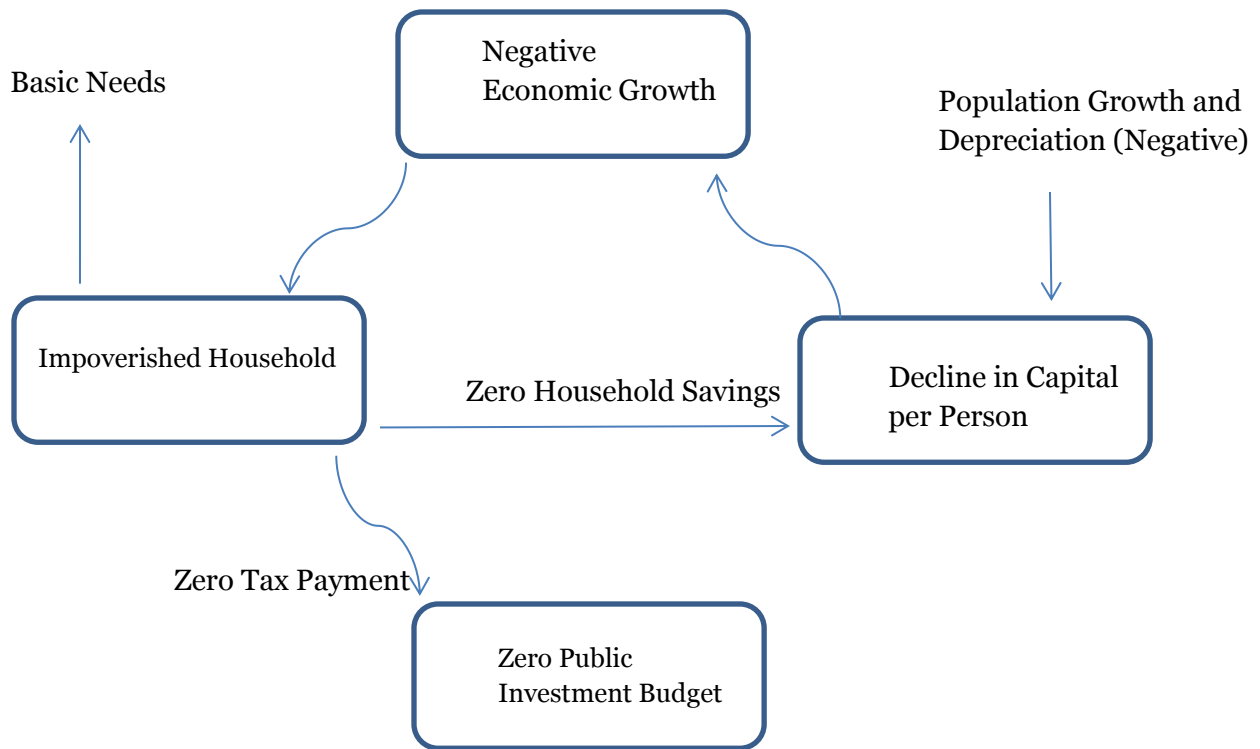
Figure 3. The basic mechanics of capital accumulation



Source: Jeffry Sachs (2006)

Now, what happens when this cycle of a normal and healthy economy is broken by poverty and the economy is trapped in poverty? Figure 4 shows the poverty trap and how it affects the household and the economy. Again starting from the left hand side of figure 4, but this time with an impoverished household, we can see that the household has very little income that it spends on basic needs. The households do not pay taxes to government and neither do they have enough income to spare for saving. This causes a decrease in capital stock and a negative economic growth. As expected, the negative economic growth in turn further impoverishes the household, resulting in a vicious cycle.

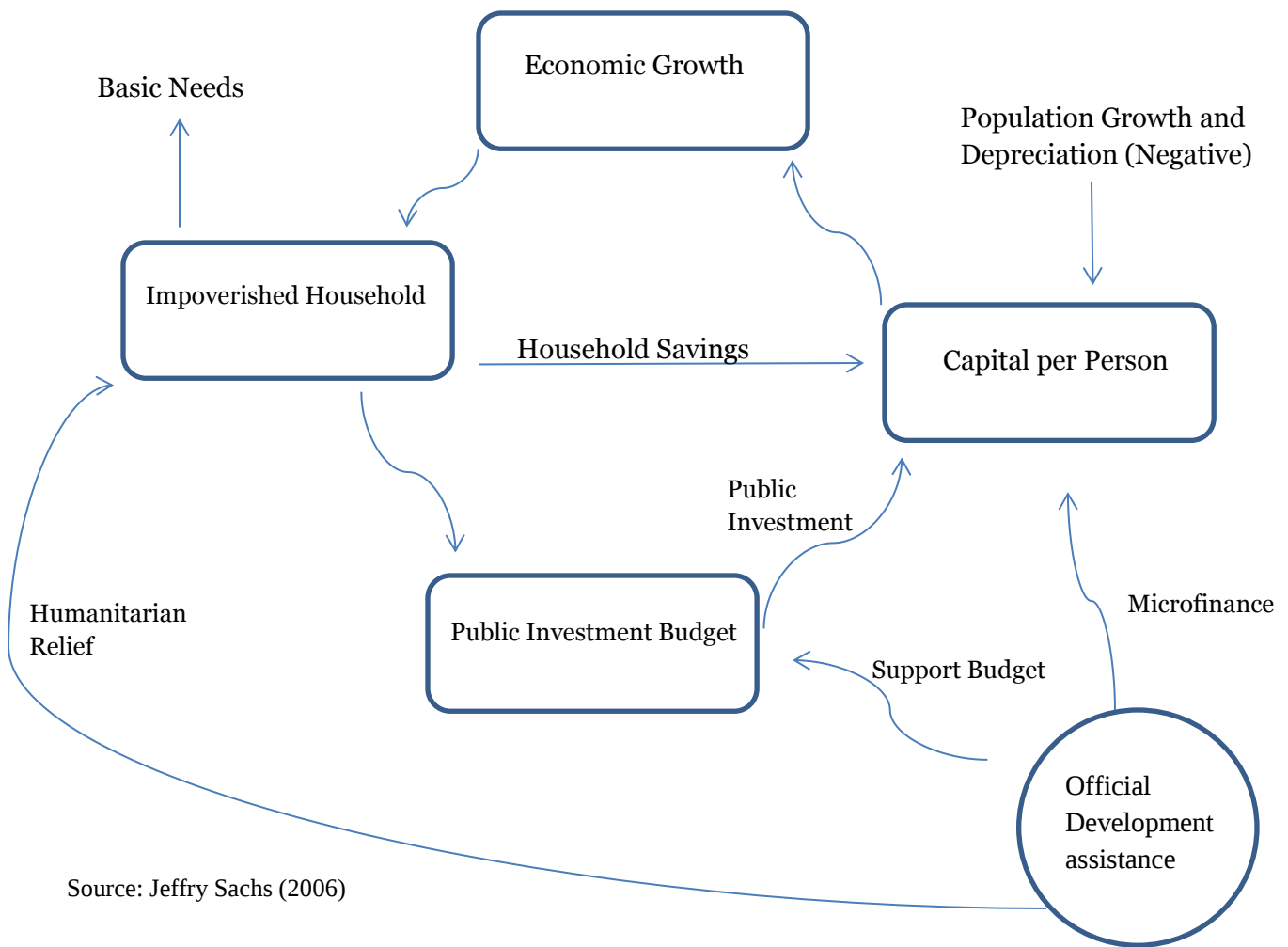
Figure 4. Poverty trap



Source: Jeffry Sachs (2006)

Sachs (2006) argues that adding official development assistance into this cycle will help break the poverty trap. He believes that foreign aid helps to jumpstart the process of raising household income, capital accumulation, and economic growth. Figure 5 illustrates this process. Starting from down-right corner, as we can see, official development assistance helps the economy in three channels.

Figure 5. The role of ODA in breaking the poverty trap



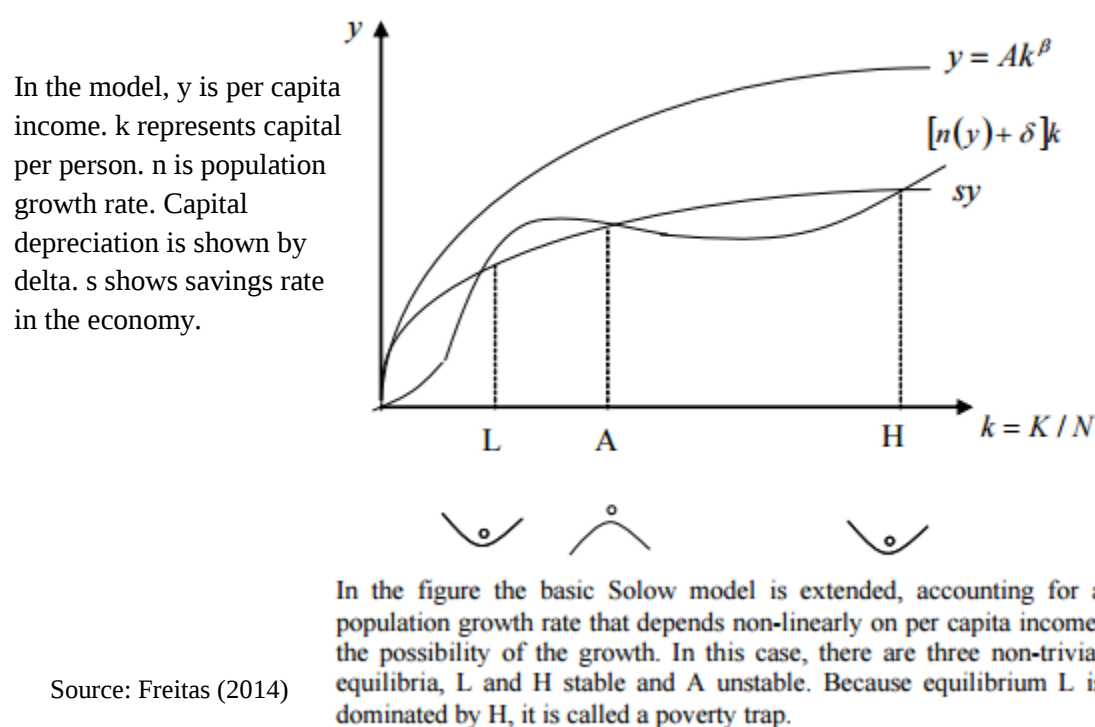
First, it helps impoverished household through humanitarian assistance in raising income. This helps the household to save what is left after satisfying the basic needs. Second, official development assistance can also be directed to supporting entrepreneurs and private businesses. Lastly, a very large portion of ODA will support public budget. This support from industrialized countries greatly helps in breaking the poverty trap in developing countries and keeps the economy running. Sachs believes that if foreign assistance is substantial and for a longer period, that will result in enough increase in capital stock to lift households above poverty line and self-sustained economic growth. At that point the economy will be running on tax

revenues and the cycle will resume to what is depicted in figure 3. This takes us to our next discussion, the Big Push idea.

2.3. The Big Push

The stylized fact of demographic transition states that a country's population growth is moderate in both extreme poverty and higher living standards (extreme poverty here refers to higher birth rates and higher death rates. The opposite is true for higher living standards). In the intermediate development stage, however, the birth rate is high and death rate is low (Barro & Sala-i-Martin, 2004).

Figure 6. Illustration of a Poverty trap



Treating population growth rate, n , in the Solow-Swan model as endogenous and adding a non-linear relationship between per capita income, y , and population growth (as a function of

per capita income), one can get a depreciation curve that is non-linear too (figure 6). Looking at figure 6 we can see that we have four equilibria in this modified model. Of which three are non-trivial. Equilibrium H is characterized by low population growth and high level of income per capita. Equilibrium A is the intermediate level with high population growth rates. Equilibrium L, the poverty trap, is characterized by low level of population growth rate and low level of income per capita. Equilibrium L is called “poverty trap” because it is dominated by equilibrium H. Both equilibria H and L are stable in this extended Solow-Swan model.

The idea for the big push is that the official development assistance from foreign developed countries to less developed countries, those in poverty trap, should be powerful enough to push the country out of the trap—to the right side of the depreciation line. To further illustrate the fact, let’s assume the economy is initially at equilibrium L, the poverty trap, and receives an amount of foreign aid to increase its capital stock. As apparent from figure 6, unless the push is big enough to move the economy to the right side of the threshold point A, the effect will be temporary: the increase in capital stock will accelerate population growth which requires a higher savings rate, s , to stand still. Since savings rate is constant, capital labor ratio falls back driving the economy back to poverty trap. As a result the demographic transition does not take place because of the low savings rate. The foreign assistance which was injected into the economy will be “spent” in increasing the population growth rate, rather than in improving the livings standards (Freitas, 2014). Therefore, the “big push” donation should be large enough to push the economy to the right side of critical point A so that the economy will be able to escape the poverty trap and reach the new steady state level of H. Of course, this big push requires sound economic policies on both donor side and recipient side.

2.4. Foreign Aid and Saving

Numerous of researchers, who are critical of foreign aid, have concluded that foreign resource inflows are in large diverted to consumption and a small portion is added to savings (Griffin, 1978; Griffin & Enos, 1970). They argue that taking into account the effect of foreign aid on reducing savings, the poor rate of return on aid-financed investment and of debt service charges, foreign inflows, especially aid, make little contribution to economic growth. However, since it is consumption that increases welfare, some researchers suggest that it may actually be considered desirable to use foreign resources to increase consumption rather than investment (Rahman, 1967). Griffin believes that in some circumstances expenditure on investment goods may have a negative return. He also believes that increased investment is neither necessary nor sufficient to achieve a high rate of growth in less developed countries, arguing that increased consumption may have a high positive return (Griffin, 1970). Assuming that saving equals to investment minus foreign inflow, the effect of foreign inflow on savings will be negative as long as the effect of an additional unit of foreign resources on investment is less than one (Papanek, 1972). Griffin also lists some possible scenarios where the flow of foreign capital may cause a decrease in savings.

First, he suggests that foreign capital may cause private domestic savings to decrease. He argues that foreign capital maybe channeled to private entrepreneurs in developing countries on loans and credits with easy terms and such debt finances may discourage investors to save. Another case might be for private foreign capital to push local and less competitive enterprises out of business by fully owning the enterprises.

Second, foreign capital may stimulate the consumption of importable and exportable goods and therefore reduce savings. Furthermore, savings might also decline by inconsistencies in tax collection (i.e., the government reduces taxation; or less effort is made to collect taxes; or given inflation, tax rates are not raised periodically) (Griffin, 1970). Therefore, we can expect the relationship between foreign capital and domestic savings to be negative (Griffin & Enos, 1970).

Papanek (1972) criticizes the approach taken by these critics and points out that they failed to specify the savings function which underlies their assumed relationship. He further discusses two savings functions which he suggests would alone or in combination decrease domestic savings and slightly increase investment as a result of foreign inflows:

1. If savings are substantially determined by government policies, then the government will be less vigorous to improve savings if foreign resources are available in greater amounts.
2. If savings are in part a function of investment opportunities and are preempted by foreign capital, then again capital inflow will be offset by compensating decline in domestic savings.

Papanek also suggests three more saving functions which, in contrast to the above two, will encourage savings and a substantial increase in investment as a result of foreign inflow.

1. Savings and income will increase with foreign capital if investment is a function of foreign exchange available to import capital goods and inputs. The importance of foreign exchange constraint has been confirmed. In addition to its contribution to investment, foreign inflows are shown to contribute to growth as well.

2. If savings are a function of the income of a particular group, e.g., exporters or industrialists, then capital inflow may rapidly increase savings by increasing the income of these groups.
3. If savings is a function of income, then as foreign resources flow into the country, a large proportion will be directed to investments as a result of donors' pressure. This will result in extra income which will cause an increase in savings.

In a nutshell, given the above assumed functions for savings, it is possible for a dollar of foreign inflow to either have an increasing or decreasing effect on savings. Furthermore, the negative statistical relationship between foreign aid and savings could be explained by savings habits⁵ of a country, as being an accounting convention (rather than a behavioral effect), conflicts and political instability, terms of trade, weather and other exogenous variables, or even statistical errors. In short, Papanek asserts that as long as both savings and inflows are substantially affected by third factors, critics' case for a negative causal relationship between foreign aid and savings is not proved by their quantitative analysis (Papanek, 1972).

2.5. Foreign Aid and Consumption

Before starting the theoretical discussion in this part, it is important to state that this part considers the individual household's spending habit, rather than a government's. That is, we assume that foreign aid flows into a country and then the government distributes the aid money to households. This part analyzes the households' decision making in both cases—receiving foreign aid as cash and receiving foreign aid as technical assistance.

⁵ Some economists believe that the problems developing countries are facing are not because of their inability or unwillingness to save but from their inability to acquire foreign exchange through exports (Griffin, 1970)

Following Barro & Sala-i-Martin (2004), and Romer (2012), I start the theoretical discussion by assumptions of the Ramsey-Cass-Koopmans model. Where we assume that the economy consists of a large number of infinitely lived households, individuals have finite lifetimes but households live forever. All individuals are identical. We further assume that the size of each household grows at a constant and exogenous rate, n . Also, households supply inelastically one unit of labor time, and rent capital to firms. The utility maximization problem of households is given by:

$$\text{maximize } U = \int_0^{\infty} u(\hat{c}(t)A(t))e^{nt}e^{-\rho t}dt$$

Assuming that $u'(c) > 0, u''(c) < 0, \lim_{c \rightarrow \infty} u'(c) = 0, \lim_{c \rightarrow 0} u'(c) = \infty$.

First I consider the flow of foreign aid into the economy which comes in the form of cash (as ODA). Therefore the above optimization function is subject to the following budget and capital accumulation constraints:

$$\hat{c}(t) + \hat{i}(t) = \hat{y} + \widehat{ODA} \quad \text{Where} \quad \left\{ \frac{w(t)}{A} + r(t)\hat{k}(t) = \hat{y} \right\}$$

$$\hat{i}(t) = \dot{\hat{k}}(t) + (\delta + n + x)\hat{k}(t)$$

Notations: (all variables with a hat means per capita of effective labor).

$\hat{c}(t)$ is consumption per productive person⁶ at time t ;

$A(t)$ is technology at time t ;

$e^{nt} = L(t)/H$, as $\frac{L(t)}{H} = L(0)e^{nt}$ where $L(0) = 1$;

H is the number of households therefore $u(\hat{c}(t)A(t))e^{nt}$ is the total household utility at time t ;

⁶ $\hat{c} = \frac{C}{AL}$, where C is total consumption, A is technology, and L is labor.

$e^{-\rho}$ is the discount factor in continuous time, which is equivalent to $\frac{1}{1+\rho}$ in discrete time;

$\hat{l}(t)$ is investment in time t ;

$w(t)$ is return to labor in time t ;

$r(t)$ is rent for capital in time t ;

$\hat{y}$ is income per capita (effective labor);

$\hat{k}$ is capital per productive labor in time t . Also, $\dot{\hat{k}}$ implies a change in capital per effective labor.

$\delta, n, \text{ and } x$ are depreciation rate of capital, population growth rate, and technology growth, respectively.

The model states that households maximize their discounted life-time utility by choosing $\hat{c}(t)$ and $\hat{k}(t)$ subject to a budget constraint first, which states that a household either consumes or invests the income it receives (from ODA, labor, and return on capital). Another constraint is the capital accumulation constraint. This constraint states that a change in capital equals to investment minus depreciation. Capital depreciates as a result of population growth, fixed depreciation, and technological improvements.

Combining both constraints in a single equation I rewrite the objective function and constraint again.

$$\text{maximize } U = \int_0^{\infty} u(\hat{c}(t)A(t))e^{nt}e^{-\rho t}dt$$

$$S.t. \quad \dot{\hat{k}}(t) = \hat{y}(t) + \widehat{ODA} - \hat{c}(t) - (\delta + n + x)\hat{k}(t)$$

The above problem is a dynamic optimization problem. Following Hoy et al. (2011) I use the optimal control theory, in particular maximum principle stated in Hamiltonian function, to

solve for the above maximization problem.⁷ As a result we get the Euler's equation (in intensive form) and resource constraint equations given below.

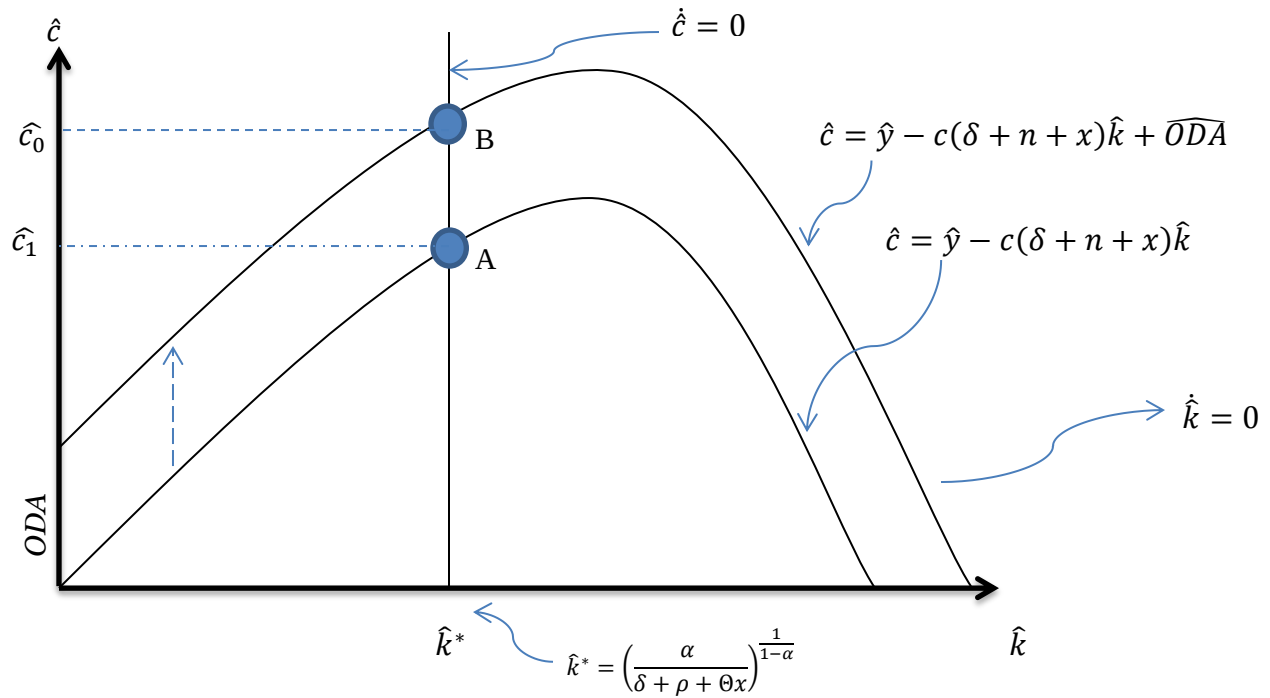
$\frac{\dot{c}}{c} = \frac{1}{\Theta} [r - \delta - \rho - x\Theta]$ In this Euler's equation, Θ is the relative risk aversion. r is $\alpha \hat{k}^{\alpha-1} = f'(\hat{y})$. Where α is the capital share in a production function and $\hat{y} = \hat{k}^\alpha$.⁸

$$\dot{\hat{k}} = \hat{y} + \widehat{ODA} - \hat{c} - (\delta + n + x)\hat{k} \quad \text{Resource constraint equation}$$

And finally the boundary and transversality conditions $\hat{k}_0 = \hat{k}(0)$ and $\lim_{t \rightarrow \infty} \lambda(t) \hat{k}(t) = 0$

Graphing both the above equations in a steady state⁹ better depicts the scenario.

Figure 7. ODA flow, consumption and capital



⁷ See appendix I for a step by step derivation. Also, interested readers can see pages (845-865), chapter 25, Mathematics for Economics by Hoy et al., MIT press for further reading on this topic.

⁸ I assume a Cobb-Douglas production function for the economy.

⁹ In a steady state $\dot{c}$ and $\dot{k}$ both equal to zero. That is, there is no consumption growth and capital accumulation in steady state.

As depicted in figure 7, official development assistance entering an economy (in form of cash) will increase income only and will not impact any other factor. Therefore, ODA will shift the consumption curve up by the amount of money entering the economy (assuming an altruistic government with no corruption). The long run equilibrium will shift from A to B and consumption increases from c_0 to c_1 . This implies that ODA in the form of cash discourages savings in the recipient country and increases consumption. Because marginal cost/benefit of investment is not affected. This is the main concern of many development economists who are opponents of foreign aid.

Now we assume that foreign aid enters the economy in the form of technical assistance. This affects the recipient country's economy through capital. Unlike the previous case, where ODA only entered into the resource constraint equation, in this case technical assistance enters both the Euler's equation and the resource constraint equation by affecting capital. Again assuming a Cobb-Douglas production function, we can rewrite the equations as follow.

$$\hat{y} = \widehat{a} \widehat{d} \hat{k}^\alpha$$

$$\frac{\dot{\hat{c}}}{\hat{c}} = \frac{1}{\Theta} [\alpha \hat{k}^{\alpha-1} \widehat{a} \widehat{d} - \delta - \rho - \Theta x]$$

$$\dot{\hat{k}} = \widehat{a} \widehat{d} \hat{k}^\alpha - \hat{c} - (\delta + n + x) \hat{k}$$

Showing the above situation in figure 8, we can see that technical assistance shifts both the consumption curve upwards and the capital line to the right. Because our capital equation at steady state changes with a change in foreign aid: $\hat{k}_1^* = \left(\frac{\alpha \widehat{a} \widehat{d}}{\delta + \rho + \Theta x} \right)^{\frac{1}{1-\alpha}}$.

Figure 8. Technical assistance flow, consumption and capital

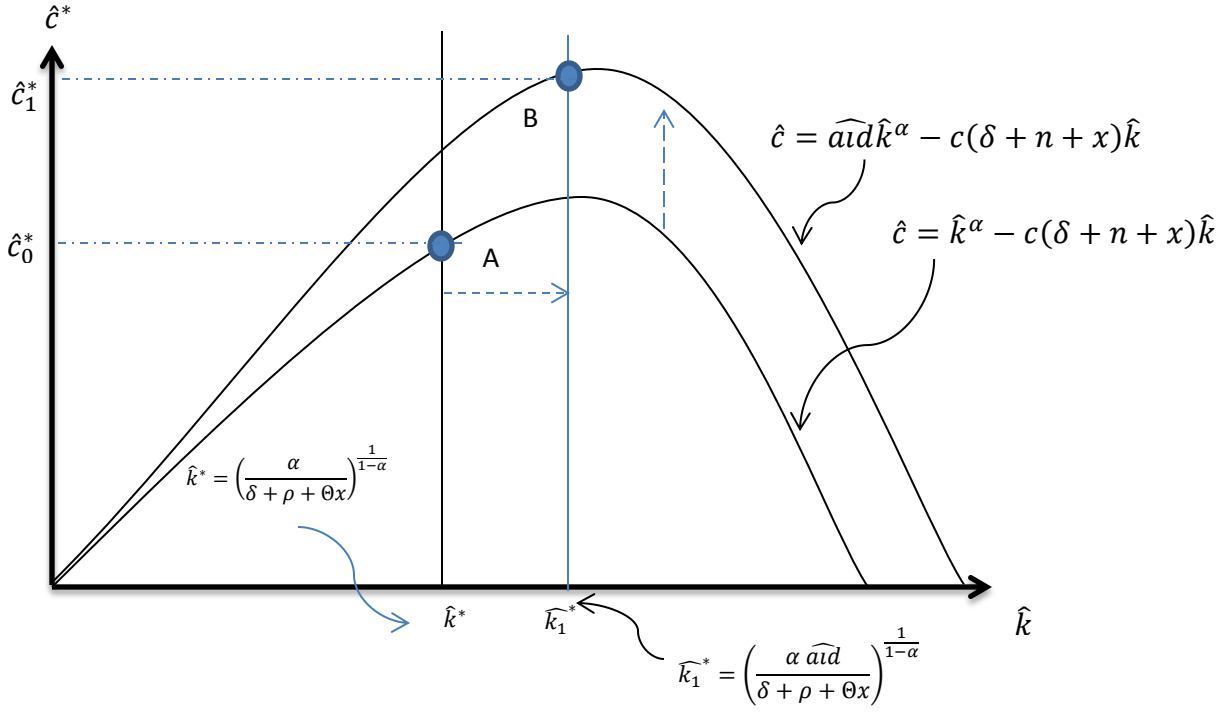


Figure 8 implies that foreign aid in the form of technical assistance will both increase capital accumulation and consumption, which is a proxy for welfare, in recipient countries.

Examining figure 8, we can see that in the long run as aid increases, income also increases.¹⁰ It is because the marginal product of capital increases. As a result consumption goes up from c_0 to c_1 and the steady state moves from A to B. For the short run, however, the impact of foreign aid depends on both substitution effect and income effect. If substitution effect surpasses the income effect then an increase in foreign aid will cause the marginal product of capital to increase, which implies a higher savings rate and lower consumption. If income effect exceeds the substitution effect, then an increase in foreign aid will lead to an increase in income and

¹⁰ As income is a function of capital. $\hat{y} = \hat{k}^\alpha \hat{a} \hat{d}$. $\hat{k}$ is also a function of aid.

ultimately an increase in consumption. These effects depend on the rate of θ which determines the movements of the saddle path.

2.6. The World Bank and the Development Theories

At the Bretton Woods Conference in 1944 the World Bank along with International Monetary Fund (IMF) were created. According to its charter, the World Bank then had the dual function of promoting reconstruction in war-torn countries and promoting economic development in less developed countries (Mikesell, 1970). Development assistance from the World Bank included promoting the flow of international capital in the form of foreign direct investments and loans. Prior to 1974 the size of loans provided by the World Bank for reconstruction and development were relatively small. It was because the Bank needed to impart confidence by following strict criteria and conservative policies.

Originally it was thought that guaranteeing loans made by private investors would establish a major activity of the Bank, but then the Bank chose to proceed with direct lending. Initially the Bank directed its loans to specific projects in developing countries that met the Bank's conditions. Later when the demand for large amount of global aid was emerging as developing countries became independent, the idea of project-based loans of the Bank and technical assistance of the U.S. government were rejected by the developing countries. Instead, to accelerate economic growth—measured by an increase in per capita income, these countries were in favor of large foreign aid programs administered by the United Nations with less strings attached to them.

To meet an annual economic growth of 2% over the 1950-1960 in these developing countries, in 1951 a group of experts issued a report of estimates to the secretary general of the

United Nations. The estimated amount required to meet the objective was 19 billion US dollars per year. Of this amount, 5 billion US dollars per year could be met by domestic savings and the remaining 14 billion dollars to be covered by assistance from foreign governments and multinational agencies in forms of grants and foreign aid (Mikesell, 1970). In the late 1950s and 1960s, the standard lexicon of foreign aid policy makers and development economists was the “take off into self-sustaining growth” hypothesis presented by Walter Rostow. To sustain economic growth, Rostow suggested that during the take off period domestic savings can be supplemented by foreign capital to increase the level of investment. Later in the 1970s, with the better understanding of the development process, the “take-off” theory became less popular.

In a series of articles in 1960s, Paul Rosenstein-Rodan developed the theory of “big push” (discussed earlier). The idea was that in order to pave the ground for the take-off, the “balanced growth theory” is required to promote development on all fronts and ensure a relatively rapid rate of growth in all sectors, including industry, agriculture, infrastructure and human skills (Mikesell, 1970). Paul’s theory was later found inconsistent and infeasible, and was rejected by other development economists (Hirschman is the best known). Economists believe that growth proceeds by process of induced investments in which one sector moves ahead of others in an economy, which in turn induces investments in other sectors of the economy (Mikesell, 1970)¹¹.

European colonial powers, too, were concerned about development assistance to their dependent territories during the nineteen and twenty centuries. This endeavor in development continued and augmented to the new independent countries after the World War II.

¹¹ Mikesell cites Hirschman, 1958.

2.7. U.S. Aid and the Marshall Plan

Although foreign aid is a post-World War II phenomenon, it was the late nineteenth century when the U.S. government started its economic assistance to developing countries (Mikesell, 1970). U.S. president, Harrison, recommended the establishment of an International American Bank to congress based on the discussions of the first international conference of American States—on April 14, 1890—which adopted a resolution to facilitate inter-American banking. The purpose of the bank was to promote the fuller exploitation of the natural resources, promote economic and financial cooperation among the American republics, and to solve any emerging economic problems (Federal Reserve bulletin, 1940). During the early years of World War II bilateral development assistance of the United States consisted mainly of Import-Export Bank loans that were used to provide project assistance and to promote U.S. exports (Mikesell, 1970). This development assistance later expanded under President Truman's point IV program which was announced in 1949 and included efforts to encourage foreign private investment and an expansion of loans for economic development. In point IV program, much faith was put on the impact of technical assistance on economic development.

While U.S. aid was flowing to Europe after the World War II and before Marshall Plan, the Marshall Plan was introduced and implemented between 1948 and 1951. The then U.S. state secretary, George C. Marshall, devised a plan to rebuild the war-torn Europe, help remove trade barriers, modernize industry, promote U.S. exports (A greater amount of Marshall Plan aid was used to import goods from the United States.), and prevent the spread of communism. Marshall believed that economic stability in Europe will bring political stability and that a wealthy Europe is in the best interest of American economy.

On top of the 14 billion U.S. dollars of United States' aid to Europe which was sent before the plan, the Marshall plan channeled over 13 billion dollars for pursuing the above mentioned objectives in Europe, with particular focus on Germany—as Germany was considered integral to European economic growth. Later in 1951 the Marshall plan was replaced by 'Mutual Security Plan' which gave away around 7 billion U.S. dollars annually until 1961.

Although a larger portion of the Marshall Plan aid was given to industrialized countries, it was divided among the participating countries based on per capita. An important aspect of Marshall Plan was that it emphasized on long term goals for economic growth in Europe. Economically, it focused mainly on modernizing industry and agriculture, encouraging trade, building transportation infrastructure, and capacity building. Furthermore, it was expected that the eastern European countries will join the plan and thus be released from the emerging soviet bloc, which did not happen.

The condition for disbursement of American aid under Marshall Plan to individual countries in Europe was that these countries were required to organize programs for themselves and that the implementation of these programs were subject to the congress approval. United States required the participating countries to independently assess their economic situations and come up with programs and that any aid is accompanied by the creation of a unified European economy. This threatened the Soviet Union and hence they did not participate in the plan and prohibited Poland and Czechoslovak from participating as well, although they wanted to.

While it was scheduled to end in 1953, the Marshall plan ended in 1951. It was because of the Korean War cost the U.S. a lot of money and internally in 1950 republicans who were against the idea of Marshall Plan won the congress.

In the period between 1948 and 1952 Western Europe experienced the fastest growth. But there are different opinions debating on whether the fast growth rate was a result of Marshall Plan. If it was, how much was it the result of Marshall Plan? Although Marshall Plan played a role in European integration and reducing the communist influence on Western Europe, it also divided the continent between the east and the west.

Later, in the mid-1960s, the U.S. foreign assistance programs were largely influenced by the foreign aid model formulated by Chenery and Strout. Although popular, Chenery and Strout model has been criticized mainly on the basis of its assumptions, which assumes that capital inflow from outside sources will equally increase the domestic capital investment. This will not happen no matter how efficiently the foreign capital flow is managed.

2.8. Who Gives Foreign Aid to Whom and Why?

Official development assistance increased steadily from the 1960s until it reached its peak in 1992 (\$68 billion). It began to decline sharply until late twentieth and early twenty first centuries. After the 9/11 attacks, ODA flows began to rebound reaching \$92 billion in 2004 following calls for debt relief and increased aid to new democracies (Radelet, 2006).

Although donors mostly provide foreign aid directly to recipient countries as bilateral assistance, they also provide aid indirectly as multilateral assistance which pools resources from many donor countries. The major multilateral institutions include the World Bank; the International Monetary Fund (IMF); the African, Asian, and Inter-American Development Banks, and the United Nations.

According to the OECD, as of 2014, United States, EU Institutions, Saudi Arabia, and Germany are the top five ODA donors with U.S. being on the top of the list. On the other hand, Afghanistan, Vietnam, Syrian, Pakistan, and Ethiopia are among the top ODA receiving countries with Afghanistan being on top (see table 1). As of 2014, a large portion of the ODA is disbursed to Least Developed Countries (LDCs) which amounts to \$43,727 million; followed by lower middle income with \$37,549 million, upper middle income with \$17,687 million, and other low income with \$3,933 million. A larger portion of the disbursed ODA which amounts to \$58,181 million was unspecified (see figure 9).

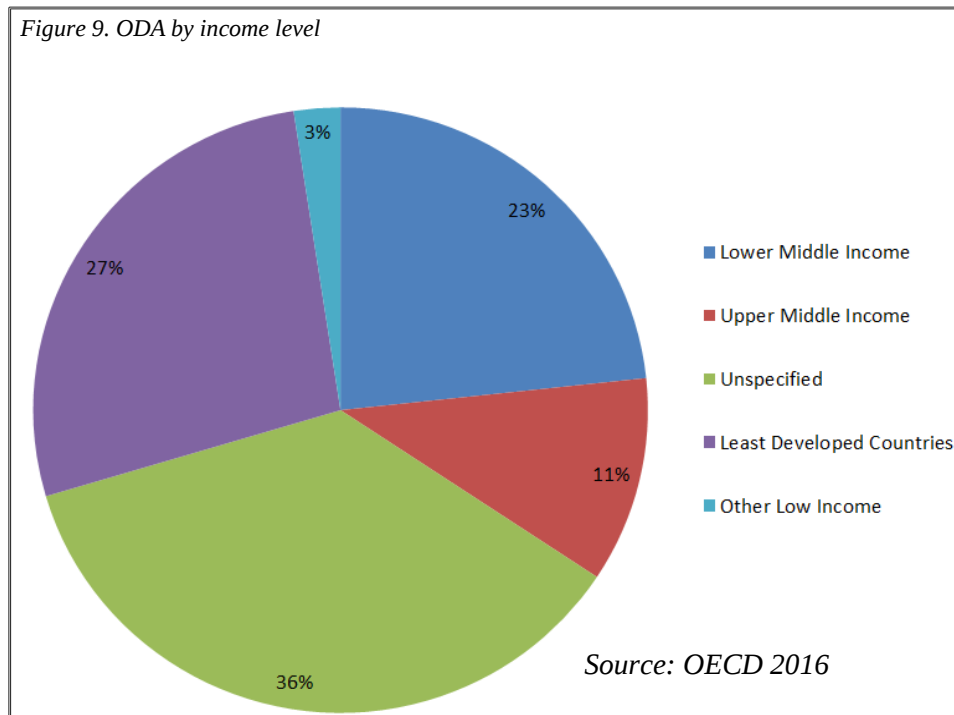
Table 1. Top 10 aid recipient/ donor countries in 2014

Top 10 recipient countries				Top 10 donor countries			
	Country	USD million	Share		Country	USD million	Share
1	Afghanistan	4,823.00	3%	1	United States	27,509.00	17%
2	Viet nam	4,218.00	3%	2	EU Institutions	16,389.00	10%
3	Syrian Arab Republic	4,198.00	3%	3	Saudi Arabia	13,272.00	8%
4	Pakistan	3,612.00	2%	4	Gernamy	11,589.00	7%
5	Ethiopia	3,585.00	2%	5	United Kingdom	11,233.00	7%
6	Egypt	3,532.00	2%	6	IDA	10,262.00	6%
7	Turkey	3,442.00	2%	7	France	6,514.00	4%
8	India	2,984.00	2%	8	Japan	6,012.00	4%
9	Jordan	2,699.00	2%	9	United Arab Emirat	4,950.00	3%
10	Kenya	2,665.00	2%	10	Sweden	4,343.00	3%
	Other Recipients	125,317.00	78%		Other donors	49,002.00	30%
Total				Total			
		161,075.00	100%			161,075.00	100%

Source: OECD

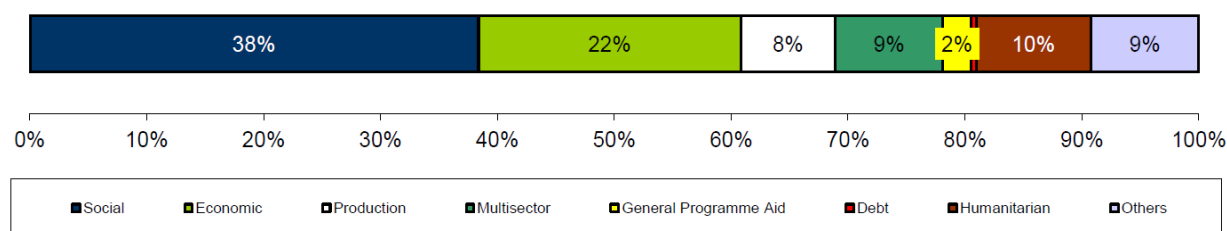
OECD also divided ODA into sector level. Figure 10 shows that 38% of ODA was committed to social sector, 22% to economic, 10% to humanitarian, 9% to multisector, and 8% to production.

Donor countries have many objectives in disbursing foreign aid. These objectives which range from political, economic development, stability, etc., may overshadow the effectiveness of foreign aid (Griffin, 1970).



Chenery and Strout (1966) believe that donor countries are more concerned about the economic and social development of recipient countries. Griffin (1970) argues that political objectives can best be achieved by focusing on highly visible, large, and dramatic projects which adversely affect the effectiveness of investment. Burnside and Dollar (1997) describe the reasons for which donors allocate their aid money as (a) low-income; (b) small number of population; and of course (c) the donors' strategic interests. They discuss that in case of bilateral foreign aid, donors' interests are the main influence. But in case of multilateral aid, it is largely determined by income level, population and policy. Norton et al. (1992) also discuss similar reasons as those of Burnside and Dollar.

Figure 10. ODA by Sectors in 2014



Source: OECD

Donor governments are also ideologically biased against government ownership of directly productive activities, which alter the pattern of investment in favor of social overhead capital and economic infrastructure, e.g., donors will tend to spend money on roads instead of factories (Griffin, 1970). Furthermore, administration style and costs of donor funded projects are also questioned by researchers. Donors focus on larger projects instead of small projects with higher potential of investments. Donors' objectives largely affect the effectiveness of foreign aid and in most cases the effect is negative. This fuels the critics, which takes us to our next discussion, aid pessimism.

2.9. Aid Pessimism

As discussed in the previous part, the international community has appropriated billions of dollars in aid in the last half century to reconstruct and stabilize the economies of developing countries. While aid proponents point out some successes as improvements in GDP growth, life expectancy, poverty reduction, child and maternal health, education, and infrastructure, aid opponents consider these improvements as relatively modest in relation to the amount of dollars poured into the developing countries as aid. Moreover, some even consider aid as an impediment to growth (Moyo, 2009).

Other scholars including Sachs, Mikesell, William Easterly and Paul Collier believe that foreign aid could be effective if it is coupled with some changes in policies. Paul Collier writes

in his book, *The Bottom Billion*, that for some developing post conflict countries, foreign aid is “too little too soon.” With the government institutions fragile and incapable of handling foreign aid, and with the weak technical capacity, these societies are not as yet ready to absorb and spend aid money wisely. He shows optimism and believes that donors are learning and they now know that post conflict countries take time in order to be able to absorb aid. Therefore aid money is more usefully phased over a decade rather than dumped in a rush (Collier, 2007).

Aid to developing countries could have been more useful had it followed the intended pattern of aid leading to investment, investment leading to growth and growth leading to poverty reduction, as was the case with Marshall Plan of the U.S. giving aid money to the Western Europe after World War II. In most developing countries, unlike the Marshall Plan, foreign money is mainly converted into expenses and no significant amount is invested in the economy, leaving a negative impact on those countries.

Dambisa Moyo (2009), another opponent of foreign aid, writes in her book that among the many side effects of aid is the “Dutch Disease” effect: flooding U.S. dollars in billions into developing countries adversely affects the economies in terms of inflation and exports. Foreign currency inflows appreciate domestic currency, making domestic goods less price competitive on the export market, and preventing exporters from competing. It also kills off demand for domestic goods, as the goods become more expensive. This causes businesses to close and people to lose their jobs, resulting in increasing poverty. With more poverty, developing countries get more aid money, ending up in a vicious cycle of aid. Furthermore, diverting dollars into the non-tradable sector also draws labor from other productive sectors, such as agriculture, leaving those sectors lagging behind.

Moyo also stresses that much of the corruption in developing countries also stems from an inflow of aid money. Aid is flowing in without question and mostly goes into the pockets of corrupt officials in a system that lacks accountability. As Peter Bauer, the famed development economist, puts it, foreign aid is “an excellent method for transferring money from poor people in rich countries to rich people in poor countries.” Corruption is especially prevalent in construction and logistics, where most of the aid money is diverted. This doesn’t mean that other sectors are safe; corruption in procurement contracts is also striking.

Foreign aid also causes governments in developing countries to underperform (Moyo, 2009; Griffin and Enos, 1970). Even in the best case scenario, when there is no corruption, aid money is spent in providing public goods including healthcare, infrastructure, security, and education. People in developing countries elect their leaders in a democratic process to provide public goods for them, writes Moyo in her book, *Dead Aid*; there is no point in elections if these goods are provided by foreign money. Furthermore, mismanaged aid hinders democracy. Because they are so dependent on foreign aid, politicians in developing countries spend much of their time courting and catering to international donors, rather than to their constituents. In addition, donors, not citizens, determine the future direction of the country, as the conditionality of aid gives donors the control over the use and direction of their funds. Thus, the opponents believe that aid dependency is having negative consequences not only economically, but politically too.

Most of the aid money is only flowing into the developing countries at the state level, where it is converted to expenses rather than savings. There is no burgeoning private sector where people can accumulate wealth or simply find jobs. As a result, there are constantly factions trying to overthrow these governments so that they can sit in power and capture the wealth which is coming into these developing countries in the form of aid. This contributes to political

uncertainty and finally to insecurity which, in turn, undermines private sector confidence and adversely affects economic activities in developing societies.

Fredrik Erixon, director of the European Center for International Political Economy (ECIP), argues that development aid is not the answer. In his article for the *Europe's world* (2006), he concludes that it is sound economic policies, not aid, that in recent decades has lifted billions of people out of poverty. China, for example, pulled more than 680 million people out of poverty from 1981 to 2010, without asking for significant amount of foreign aid (The Economist, 2013).

In a recent study released in December, 2015, the Global Financial Integrity (GFI) and the Centre for Applied Research show that since 1980 developing countries have lost 16.3 trillion US dollars through illicit financial outflows. In 2012, according to this study, developing countries received 1.3 trillion US dollars in aid, investment, and income from outside. The same year some 3.3 trillion US dollars flowed out of these countries through illicit leakages. These illicit leakages, which supply tax havens, include trade misinvoicing, unrecorded financial transfers, and broad leakages in the balance of payments. In their report, Mr. Baker, President of Global Financial Integrity states that illicit financial flows and offshore tax havens are the main drivers of inequality in developing countries. The study suggests that capital inflows, including official development assistance and foreign direct investments, will drain through the illicit channels and into offshore tax havens, adversely affecting the developing countries¹².

Paul Collier asserts that to improve foreign aid effectiveness, some changes in policies, which directly or indirectly promote corruption or hinder the development process, are required. But aid can't be an instrument for development per se. The current trend is based on an ugly

¹² Financial Flows and Tax Havens:
Combining to Limit the Lives of Billions of People

equation: the poorer the country, the more aid it will receive. This has to change. Donors should help developing countries based on the progress they make toward development. This will provide an incentive for the developing societies to go forward and to catch up with the rest of the developed world. Targeting aid at sustainable growth rather than at photogenic social priorities, coupled with a strong monitoring system to fight corruption, will also help in effectiveness of aid. To prevent aid money from leaving the developing countries, Collier suggests that the international community needs to bring some changes in their banking systems and start treating money with unknown sources the same way as they treat money linked to terrorism. The bigger burden, of course, lies on the shoulders of developing countries: to reform the system, increase accountability, and provide a suitable environment for investments (Collier, 2007).

2.10. Summary of Previous Work

Generally, literature on foreign aid can be divided into two categories. First category of literature discusses the determinants of foreign aid (i.e. who gives foreign aid to whom and why?) and the second category of literature discusses the impact of foreign aid on economic growth. The first category of literature concludes that although the prime motivations for multilateral aid prove to be development and humanitarian, bilateral aid is more based on political motives than economic or development (Alesina & Dollar, 2000; Radelet, 2006; Boone, 1996; Burnside & Dollar, 1998). The latter category of literature which discusses the impact of foreign aid on economic growth has mixed results, depending on policies in the recipient country. That is, the literature found either negative relationship between foreign aid and economic growth or the opposite. Some literature even concludes that the impact of foreign aid on economic growth is neutral. A brief summary of some important papers is following.

Chenery and Strout (1966) quantitatively analyze the process of development with external assistance by outlining a theoretical framework design. They then use this framework to evaluate the current performance of developing countries and assess their future needs for assistance under various assumptions. They first assume that aid is expensive and the recipient country cannot increase aid merely to increase consumption. Second assumption is that the country maximizes consumption until the target growth rate is attained. The authors conclude that in the short run the effectiveness of external resources depends on their use to relieve shortages of skills, savings, and imported commodities. In the long run, for the economy to run independently of foreign assistance, additional outputs should be allocated to increase savings and reduce trade gap.

Chenery and Strout also come up with some policy implications for both recipients and donors. They warn the recipient countries that dependence on substantial amounts of foreign aid, albeit it reduces the time required for a country to achieve a satisfactory rate of growth, creates some special policy problems. Hence, growth policies are required to be adjusted to different phases of transition. In a lower growth rate, policy should focus on increasing output, implying an increase in the quality and quantity of both physical capital and human resources inputs. Besides, countries should start raising taxes and savings in this stage. To prevent further increases in the balance of payments deficit, countries should start bringing about the changes in the productive structure, a much harder task. They also need to divert income into saving.

Their policy suggestions for donors are on the details of transfer of assistance, e.g., basis for determining the amount of transfer; specification of the forms of resources to be furnished; and a basis for controlling their use. They also suggest allocating assistance primarily on the basis of

expected development performance, although these are complicated by varying political objectives of the donors.

Mosley et al. (1987) develop a model to evaluate the effect of aid on growth at three levels: (a) the direct effect; (b) the indirect effect on spending patterns of the public sector of recipient; and (c) the effect on government policies by reshuffling the government's entire spending program. The authors assume in their model that the recipient country's objective is to maximize utility in public sector, given budgetary constraints. They conclude their paper by finding it impossible to establish any statistically significant correlation between aid and growth of GNP in Least Developed Countries (LDC). The authors also recommend that donors should concentrate their aid on countries with good economic policies in which the effectiveness of aid is high. However, they also insist that the case of each individual country should be examined before applying these criteria.

Rana & Dowling (1988) argue that foreign capital could have a negative effect on savings on two accounts. First, governments receiving foreign capital may relax taxation and increase consumption, and/or liberalize imports. Second, foreign capital, in the form of foreign private investment, could push domestic investments out, and therefore decrease savings. Furthermore, by introducing inappropriate technology to the aid receiving country, foreign capital could cause inefficiency in the recipient country's economy. The authors explored the relationship between economic growth, foreign capital, foreign direct investment, domestic savings, exports, and income per capita. Their target variables are foreign capital, economic growth, and domestic savings. In order to see the total effects (direct and indirect) of exogenous variables on endogenous variables (savings and growth), the authors used a simple two-equation system, which they believe will take care of simultaneity and remedy this problems. An interesting point

to take note of is that following Iwasaki (1985) the authors treat foreign capital inflow, both in terms of aid and foreign private investment, as exogenous in the model. The reason for this is that if we treat aid and FPI as endogenous, the results will contain a specification bias. Iwasaki has shown that in most cases causality runs from foreign capital to the growth rate and saving rather than the other way. Using cross-section and time-series data from nine Asian developing countries with fifty four observations for the period 1965-82, the authors estimated both reduced form estimates and total effects of foreign capital, both aid and FPI, on growth rate and domestic saving rate. Their findings show that foreign aid has a positive effect on growth rate in Asian developing countries. However, it replaces savings. Foreign private investment, on the other hand, has a positive effect on both growth rate and saving rate.

Burnside & Dollar (1997) use a modified neoclassical growth model to analyze the links between foreign aid, economic policies, and growth of per capita GDP. Using panel data for 56 countries and six four-year time periods from 1970-1973 until 1990-1993, they estimate the model. One plus point for their analysis is that they use a new database on foreign aid developed by the World Bank to reach conclusion. This database distinguishes between grants and concessional loans. The authors' findings show that for countries with average policies foreign aid has zero impact. Countries with good policies and significant amount of foreign aid, on the other hand, benefit largely from receiving foreign aid. In fact, in their model, the growth of the latter is best correlated with foreign aid. The authors also find that bilateral aid increases public consumption and government spending. This shows that aid is fungible, i.e., aid tends to increase government spending in other sectors as well as the sector aid is directed to.

The impact of foreign aid on agricultural growth and agricultural imports, however, has received little attention. A summary of the papers on these two topics is following.

Houck (1988) analyses 1983-84 cross-sectional data for low-income and middle-income countries to explore the link between agricultural productivity and economic performance in these two groups. He also looks at the relationship between economic performance and agricultural imports. In his analysis, he finds a positive relationship between these variables and concludes that agricultural growth in less developed countries, stimulated by either internal or external factors, may lead to better economic performance and ultimately to increased agricultural imports in the long-run. He further adds that the case for middle-income countries is less clear. However, nothing in the data suggests that improving agricultural productivity in these nations is threatening to U.S. agricultural trade in the long-run.

On a similar topic, De Janvry and Sadoulet (1988) explored the link between agricultural growth and industrialization of LDCs and the link between growth in LDCs and agricultural imports. Using both intercountry econometric analysis and simulation analysis in archetype general equilibrium models, the authors conclude that there is a positive relation between rapid income growth and increasing demand for the US agricultural exports.

Norton, Ortiz and Pardey (1992) reviews the rationale of foreign aid to agriculture and analysis the effects of ODA on agricultural growth in different countries and regions, and in different stages of growth. Applying a Cobb-Douglas production function and multicollinearity analysis, the authors find that aid has been less effective for countries with high levels of external debt. Furthermore, the authors find that aid effectiveness was significantly different by region but do not offer an explanation to why that is the case. Their results also suggest that aid effectiveness did not vary by income level or by the relative importance of agriculture sector.

Kherallah et al. (1994) explored the links between official development assistance on agricultural growth, savings and agricultural imports in 56 developing countries over the period 1975-1990. The study uses simultaneous equation model treating agricultural growth, official development assistance, imports and savings as endogenous interdependent variables. The authors find that development assistance promotes agricultural growth and leads to larger food imports.

Chapter 3. Methodology and Data

The first section of this chapter contains a deterministic simulation of previous research results presented by Kherallah et al. (1994). In the original paper the authors explored the links between ODA, agricultural imports, savings, and agricultural growth, and other macroeconomics variables while considering only direct effects in reporting the estimates. In this part, I first convert the original estimates into elasticities and then perform a deterministic simulation to take into account the total effect of exogenous macroeconomic variables on ODA, agricultural imports, savings, and agricultural growth.

The second section of this chapter contains an econometric analysis and discussion of results to explore the links between the above mentioned variables. I also discuss the model used, and data sources, and data treatment in this last part of this chapter.

3.1. Part 1: Deterministic Simulation

I attempted to replicate a paper by Kherallah and colleagues (1994), but I failed to do so for a series of reasons. Despite contacting all four authors, unfortunately I was not able to acquire complete data for all variables as the sources for original data used in the analysis are ambiguous, and the computer software used by authors is also unknown. Furthermore, since all data is on macroeconomic level, it is frequently subject to change by governments and international institutions which makes the replication task even more difficult (Tomek, 1993). In the original paper the estimates presented by the authors are partial, i.e., the effect of each exogenous variable on an endogenous variable is estimated holding other variables constant.

Since estimates produced by the original authors are partial, I attempt to simulate total elasticities to see how particular variables react allowing other variables change. Using Kherallah et al.'s work I alter the model variables and choose only those variables which are significant in terms of t-statistics. In this work, I follow the original paper and treat agricultural growth, savings, ODA and agricultural imports as endogenous. I explore the links between exogenous variables and endogenous variables in this part and of special interest is the total effect of trade (both agricultural and non-agricultural) and tax revenues on agricultural growth, agricultural imports, and savings.

Kherallah et al. (1994) conclude that ODA to developing countries will increase agricultural imports in these countries. As foreign aid leads to increases in income, which leads to increased demand for imports, including agricultural products. This result answers the concerns of those groups arguing that development assistance leads to productivity increases and greater agricultural output in developing countries, thus reducing industrialized countries' farm exports. I will consider both agricultural and non-agricultural trade in the model to see how these affect endogenous variables, letting all other variables change. Development workers are also interested in macroeconomic policy variables including foreign exchange holdings, income, and taxes. These are also accounted for in this model. I will also have a look at how non-agricultural growth affects endogenous variables, especially agricultural growth, savings and ODA.

As discussed earlier, I rewrite the equations from Kherallah et al., with changes in the list of exogenous variables. I chose the most significant variables in terms of t-statistics. In contrast to original paper, here I use total elasticities to find the link between endogenous variables and exogenous variables. I derive the structural form of all four equations in the following steps.

Agricultural growth equation:

$$GRA = f\left(\sum_{j=-1}^6 \beta_j ODA_{t-j}, SAV, FPI, AGTR\right) \quad (1)$$

Savings equation:

$$SAV = f(GRA, ODA, FPI, PCY, AGTR, NAGTR, TAXR) \quad (2)$$

Official development assistance equation:

$$ODA = f(GRA, SAV, AGIMP, PCY, GRNA) \quad (3)$$

Agricultural imports equation:

$$AGIMP = f(GRA, ODA, PCY, FEL) \quad (4)$$

Rewriting the above equations again, I get:¹³

$$GRA^* = \varepsilon SAV^* + \varepsilon_1 \sum_{j=-1}^6 \beta_j ODA_{t-j}^* + \varepsilon_2 FPI^* + \varepsilon_3 AGTR^* \quad (5)$$

$$SAV^* = \varepsilon_4 GRA^* + \varepsilon_5 ODA^* + \varepsilon_6 FPI^* + \varepsilon_7 PCY^* + \varepsilon_8 AGTR^* + \varepsilon_9 NAGTR^* + \varepsilon_{10} TAXR^* \quad (6)$$

$$ODA^* = \varepsilon_{11} GRA^* + \varepsilon_{12} SAV^* + \varepsilon_{13} AGIMP^* + \varepsilon_{14} PCY^* + \varepsilon_{15} GRNA^* \quad (7)$$

$$AGIMP^* = \varepsilon_{16} GRA^* + \varepsilon_{17} ODA^* + \varepsilon_{18} PCY^* + \varepsilon_{19} FEL^* \quad (8)$$

The asterisked variables indicate relative change in that variable (e.g. $X^* = \frac{dX}{X}$). Also, a definition of variables is available in appendix VII.

¹³ Please see appendix II for a step by step derivation.

In the equations above agricultural growth, savings, official development assistance, and agricultural imports are endogenous variables. The exogenous variables are foreign private investments, agricultural trade, domestic income, non-agricultural trade, and tax revenues.

Table 2. Definition and baseline values of parameters

Item	Definition	Value ^a
ε	Agricultural growth elasticity of savings	1.540972
ε_1	Agricultural growth elasticity of ODA	0.730444
ε_2	Agricultural growth elasticity of foreign private investments	-0.15944
ε_3	Agricultural growth elasticity of agricultural trade	0.127315
ε_4	Savings elasticity of agricultural growth	0.019079
ε_5	Savings elasticity of ODA	-0.23985
ε_6	Savings elasticity of foreign private investments	0.047697
ε_7	Savings elasticity of domestic income	0.170177
ε_8	Savings elasticity of agricultural trade	0.041009
ε_9	Savings elasticity of non-agricultural trade deficit	-0.14343
ε_{10}	Savings elasticity of tax revenues	0.28106
ε_{11}	ODA elasticity of agricultural growth	0.012273
ε_{12}	ODA elasticity of savings	-0.75047
ε_{13}	ODA elasticity of agricultural imports	0.819375
ε_{14}	ODA elasticity of domestic income	-0.34057
ε_{15}	ODA elasticity of non-agricultural growth	0.058144
ε_{16}	Agricultural imports elasticity of agricultural growth	-0.01977
ε_{17}	Agricultural imports elasticity of ODA	0.495378
ε_{18}	Agricultural imports elasticity of domestic income	0.205744
ε_{19}	Agricultural imports elasticity of foreign exchange holdings	0.193826

Note: ^a The elasticities are computed based on data from Kherallah et al. (1994). Only significant variables were picked up from Kherallah et al.'s work.

3.1.1. Reduced Form

Using ‘reduced’ form of the model, I derive ‘total’ elasticities. Following Kinnucan & Myrland (2002), I first express the model in matrix notation as following:

$$\Pi Y = \Gamma Z \quad (9)$$

Where Π is a 4x4 matrix of parameters corresponding to model's endogenous variables; Y is a 4x1 vector of endogenous variables; Γ is a 4x7 matrix of parameters corresponding to the model's exogenous variables; and Z is a 7x1 vector of exogenous variables. Inverting Π and pre-multiplying it by (9), yields:

$$Y = EZ \quad (10)$$

Where $E = \Pi^{-1}\Gamma$ is a 4x7 matrix, containing total elasticities of the model. To compute E , I use Microsoft Excel software to get the model results.

3.1.2. Results

By looking at the results in table 3, one can see that total effects are greater in magnitude than the partial effects because I allow for all variables to change, *mutatis mutandis*. Examining table 3, one can see that the relative effects of income per capita and tax revenues along with non-agricultural trade deficit on all dependent variables are significant in magnitude. Contrary to income, foreign private investment has a relatively smaller effect on all dependent variables.

Table 3. Partial effect vs. Total effect of exogenous variables on endogenous variables

Endogenous Variables	Exogenous Variables													
	Partial Effect (from original paper)							Total Effect (derived using MS Excel)						
	FPI	PCY	AGTR	NAGTRD	TAXR	FEL	GRNA	FPI	PCY	AGTR	NAGTRD	TAXR	FEL	GRNA
Ag-Growth	-0.159		0.127					-0.119	0.001	0.166	-0.129	0.253	0.140	0.051
Savings	0.047	0.170	0.041	-0.143	0.281			0.065	0.344	0.064	-0.210	0.411	-0.088	-0.032
ODA		-0.340					0.058	-0.081	-0.724	-0.082	0.266	-0.520	0.377	0.138
Ag-Imports		0.205				0.193		-0.038	-0.153	-0.044	0.134	-0.263	0.378	0.067

Note: Blank spaces mean that the estimates were not reported in the original paper.

Focusing on income per capita, the results in Table 3 indicate that it is a fairly important exogenous variable in the model. As expected, its effect on official development assistance is negative. It is because most of the foreign aid goes into the less developed countries with lower income per capita. The effect of income per capita on savings is estimated to be positive. An increase in income per capita will increase savings by almost a half. Kherallah et al. (1994),

Norton et al. (1992), and Houck (1988) argue that an increase in ODA will increase agricultural imports into developing countries. The basis for their argument is that increasing ODA will lead to increased agricultural growth and therefore a higher income per capita. This increase in income per capita will then lead to increased agricultural imports. The result here shows a negative link between agricultural imports and income per capita, however. Implying that, *mutatis mutandis*, increasing income per capita modestly reduces agricultural imports.

Although the effect of foreign private investment (FPI) is relatively small, it gives us interesting information. The link between FPI and ODA is negative. This confirms the fact that FPI is an alternative for foreign aid, official development assistance to be precise.

Overseas demand for agricultural goods helps agricultural growth and savings in developing countries. Results in table 3 show that an increase in agricultural trade will accelerate agricultural growth. Agricultural trade helps in improving post-harvest management techniques and standardizing agricultural marketing value-chain in developing countries, as growers and traders will have to adjust themselves with the overseas consumers' preferences. Agricultural trade also contributes in savings. Agricultural trade brings foreign exchange into the developing countries which then can be invested in agricultural sector as well as other sectors.

Foreign aid opponents suggest trade in their list of recommendations as one of the alternatives. They argue that increasing trade between developing countries and the developed world will help the poor countries to alleviate poverty. Removing trade barriers such as tariffs on agricultural imports from the developing countries and removing subsidies on the same products in the developed world will help agricultural sector to grow in the developing countries. This will eventually decrease the foreign aid flow to these countries. The findings are consistent with this

claim. That is, increased agricultural trade will reduce foreign aid and increase saving (see table 3). Table 3 also shows that non-agricultural trade deficit harms savings and agricultural growth in developing countries. Furthermore, since trade deficit is one of the many characteristics of less developed and poor countries, it indicates an increasing donor attention to the poor countries.

The effect of tax revenue on all endogenous variables is also noteworthy. Tax revenues encourage agricultural growth and helps increase savings. This is consistent with the original paper. The results also support the claim that foreign aid is channeled to increasing consumption in developing countries and hence discouraging taxation (Griffin, 1970). Furthermore, table 3 shows that increasing tax revenues by ten percent will decrease ODA by approximately five percent.

As mentioned in the beginning of this section, the replication process failed because of lack of complete data, and ambiguous data sources used by the authors. Vague missing data treatment was also a barrier. Therefore, I attempted to collect data on the same pre-selected variables and use the same model to do an independent analysis discussed next.

3.2. Part 2: Econometric Analysis

Although the link between foreign aid and economic growth has been widely discussed, little attention has been paid to the link between foreign aid and agricultural growth. Kherallah et al. (1994), Norton et al. (1992), and Houck (1988) have explored the links between agricultural growth, ODA, and agricultural imports. This part examines the links between agricultural growth, ODA, and agricultural imports using instrumental variables with fixed effects model. Of special interest here is the impact of ODA on agricultural imports into developing countries.

3.2.1. Model

Recent work from researchers who analyzed the effect of ODA on growth and saving suggests that the use of simultaneous equation model is more appropriate (Kherallah et al., 1994; Rana & Dowling, 1988). They argue that using single equation model will overstate the positive effect of ODA on growth and aid's negative effect on savings rate (Kherallah et al., 1994). Furthermore, using a single equation system will not take into account the causality that runs both ways between savings and growth. In other words, savings rate is influenced by growth and influences growth. Additionally, poor countries with lower rates of growth and savings tend to receive more of foreign aid—implying that foreign aid, savings, and growth are simultaneously determined. Another argument is that foreign aid encourages agricultural imports from donor countries into the recipient country (Kherallah et al., 1994; Ruttan, 1989). This suggests that agricultural imports are also influenced by ODA, and vice versa.

To take care of simultaneity problem, and to explore the relationship between agricultural growth, saving, and ODA, I use two stage least squares with fixed effects model in which agricultural growth, savings, ODA, Agricultural trade, and agricultural imports are treated as endogenous.

Following Norton, Ortiz, and Pardey (1992) agricultural growth equation (Eq. 11) is estimated using restricted quadratic distributed lag¹⁴ of ODA to account for the current and past effects of ODA. The justification for using quadratic distributed lag for ODA is that when moving forward from the initial year, the effects of foreign aid on agricultural growth are distributed over time. The effects are expected to be smaller in the early years due to the time

¹⁴ Please see Appendix IV for the steps involved in ODA lag specification.

needed for development, extension, and adoption of new technologies within the indigenous farming system. Net agricultural exports (agricultural trade) and foreign direct investment (FDI) are also included in the growth equation because foreign direct investment both augments resources available for capital formation and improves investment efficiency (Rana and Dowling, 1988). FDI involves the transfer of resources such as technological, managerial, and marketing expertise in addition to capital (IMF, 1985)¹⁵. Exports, on the other hand, tend to encourage specialization, increase foreign exchange, and facilitate access to technology, especially agricultural inputs (Rana and Dowling, 1988). These two variables along with domestic savings targeted at agriculture are all considered investments and determinants of growth (Papanek, 1973). Causation runs from macroeconomic policy to growth and growth is negatively associated with inflation (Fischer, 1993). Therefore, inflation is also included in equation 11 to take care of macroeconomic performance and policy changes, as many economies experienced high inflation rates. Finally, the effect of international environment on developing countries was captured by including terms of trade in equation 11.

$$GRA = f\left(\sum_{s=-1}^6 \beta_s ODA_{t-s}, SAV, FDI, AGTR, TOT, INF\right) \quad (11)$$

$$SAV = g(ODA, GRA, GRNA, FDI, AGTR, NAGTRD, PCY, TAXR) \quad (12)$$

$$ODA = h(GRA, GRNA, SAV, AGIMP, NAGIMP, PCY, DR) \quad (13)$$

$$AGIMP = j(ODA, GRA, PCY, INF, TR) \quad (14)$$

Following Mikesell & Zinser (1973), I set up the savings rate function as in equation 12. Griffin (1970) argues that the link between ODA and savings is inverse. Foreign capital inflow reduces private domestic savings by discouraging investments, or pushing local enterprises out

¹⁵ Occasional paper (1985)

of business. Furthermore, foreign capital stimulates consumption of importable goods and therefore reduces savings. Governments receiving foreign capital may also attempt to reduce taxes. As discussed in chapter two, these assumptions are criticized by other researchers (Papanek, 1972; Mikesell and Zinser, 1973). Therefore, inclusion of official development assistance in the savings equation will help us understand the effect of ODA on consumption and savings. Foreign Direct Investment (FDI) is also included in savings function and is expected to have a positive effect on saving (Dhar & Roy, 1996). Richer countries tend to save more, suggesting a positive relation between savings and income per capita (Kherallah et al., 1994). Macroeconomics theory also suggests a positive relation between savings and per capita income (Romer, 2012). Agricultural and non-agricultural growth leads to an increase in income in developing countries, therefore leading to an increase in savings (Kherallah et al., 1994).¹⁶ Net exports of agricultural and non-agricultural commodities result in securing foreign exchange and thus increase per capita income. Both agricultural trade and non-agricultural trade are expected to be positively related to savings. Therefore, non-agricultural trade deficit variable is also included in the savings equation and is expected to have a negative effect on savings. Although dependency ratio (percentage of population below 14 and above 64 years of age) has been previously used by authors in savings rate function (Kherallah et al., 1994; Gupta and Islam, 1983), following Rana and Dowling (1988), I exclude the dependency rate in the savings equation as it is highly correlated with income per capita. Taxation is regarded by development economists as an extremely important variable in the savings rate function. Most of the literature shows a positive relationship between taxation and savings (Mikesell and Zinser, 1973).¹⁷

¹⁶ The authors cite Gupta and Islam (1983)

¹⁷ The authors cite Heller (1967)

The ODA equation (Eq. 13) includes shares of agricultural and non-agricultural output growth, domestic savings, and imports—separated as agricultural and non-agricultural. Income per capita and dependency ratio are also included. As mentioned before, empirical results on the link between growth and ODA are mixed. Agricultural and non-agricultural variables are included to explore their link with ODA. Savings rate is expected to be negatively related to ODA, as a large number of literature suggest that ODA will replace savings (Kherallah et al., 1994; Griffin, 1970; Griffin & Enos, 1970). A large portion of foreign aid is said to be directed towards poor countries. Therefore, including income per capita is also of interest to us. I also included imports in this equation to explore its link with ODA and to see whether ODA is used to fill the trade gap created by large imports. Furthermore, one of the characteristics of poor countries is higher fertility rate and hence a higher dependency ratio. Adding dependency ratio will help us understand the objective of ODA—whether it is political or humanitarian.

Finally, in the last equation (Eq. 14) I try to explore the relationship between ODA and agricultural imports to answer the question whether ODA increases trade ties with donor countries. Agricultural output growth and increased income per capita suggest an increase in agricultural imports and therefore are included (Kherallah et al., 1994; Houck, 1988). I also included some macroeconomic variables, such as total reserves and inflation which affect a country's purchasing power.

3.2.2. Data

The sample used for this study covers 46 developing countries for the period 2002-2014. Sample selection is based on World Bank definition of developing countries, and data availability. I follow Kherallah et al. (1994) in selecting variables. To take care of

heteroscedasticity, most of the variables are divided by GDP (except for agricultural value added, income per capita, inflation rate, dependency rate, and terms of trade).

Foreign direct investment, agricultural growth rates, gross domestic savings, inflation rates, dependency ratio, terms of trade, and income per capita are taken from World Bank and IMF exactly as it is. Non-agricultural growth rate was calculated by subtracting agricultural GDP from total GDP and then calculating its growth rate. Net total ODA and agricultural ODA in dollar amount were acquired from OECD¹⁸ and then divided by GDP to get ODA as per cent of GDP. Dependency ratio is the ratio of dependents—people younger than 15 or older than 64—to the working-age population—those ages 15-64 (World Bank, WDI). Agricultural imports and exports are from Food and Agriculture Organization of the United Nations (UNFAO) in nominal U.S. dollars converted to percent of GDP. Worth mentioning agricultural exports and imports for 2014 were estimated by a three-year moving average. Agricultural trade is the difference between agricultural exports and agricultural imports in percent of GDP. Nonagricultural imports (exports) were calculated by removing agricultural imports (exports) (in level) from total imports (exports). The results were then translated into percent of GDP. Total reserves include holdings of monetary gold, special drawing rights, reserves of IMF member held by the IMF, and holding of foreign exchange (World Bank, WDI). Tax revenues for Zambia, Zimbabwe, and Mauritania are acquired from African Economic Outlook of African Development Bank (ADB), as tax data for these countries was not available on World Bank and IMF databases. Missing values, which were not significant, for all variables, except for agricultural research spending, are taken care of by three-year moving average. A list of data sources and also a summary of data are shown in appendix VI.

¹⁸ Organization for Economic Co-operation and Development

3.2.3. Results

Table 4 includes the results for both the Ordinary Least Squares (OLS) and the Two Stage Least Squares (2SLS). One can see that OLS exaggerates the effect of independent variables on dependent ones. 2SLS, however, takes the fact of endogeneity into account. Interpretation of results is based on 2SLS. OLS is reported just for comparison.

3.2.3.1. Agricultural Growth Equation

Although the results in agricultural growth equation are less conclusive, it gives us valuable information on policy variables. The effect of official development assistance on agricultural

Table 4. Results of OLS and 2SLS estimation of agricultural growth, savings, ODA, and agricultural imports for 46 developina countries from 2002-2014.

Explanatory Variables	Agricultural Growth		Savings		ODA		Agricultural Imports	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
GRA			0.02 (1.28)	0.04 (0.44)	-0.005 (0.23)	0.20 (2.23)	-0.001 (0.17)	-0.12 (2.79)
ODA total (contemporaneous)	0.04 (1.54)	0.04 (0.96)	-0.25 (5.97)	-0.67 (3.36)				
ODA total (long-run)	0.42 (1.54)	0.41 (0.96)						
AgODA							1.14 (3.97)	1.21 (3.03)
NonAgODA							0.03 (1.90)	0.25 (3.32)
AGTR	0.47 (1.43)	0.16 (0.11)	0.78 (8.03)	0.62 (2.45)				
AGIMP					0.16 (1.28)	0.56 (1.15)		
SAV	0.05 (0.45)	0.29 (0.58)			-0.19 (5.43)	-0.13 (1.49)		
FDI	0.12 (1.15)	0.11 (0.98)	0.2 (4.44)	0.13 (2.27)				
GRNA			0.11 (3.35)	0.08 (1.70)	-0.01 (0.49)	-0.08 (1.73)		
PCY			0.001 (6.11)	0.001 (4.28)	-0.0001 (0.41)	0.0001 (0.37)	0.0001 (1.50)	0.0001 (1.16)
INF	-0.16 (4.53)	-0.14 (2.63)					0.01 (3.52)	-0.003 (0.36)
DR					0.17 (3.03)	0.17 (2.60)		
NAGIMP					-0.09 (3.88)	-0.07 (3.09)		
NAGTRD			-0.55 (16.62)	-0.54 (14.53)				
TOT	0.02 (0.82)	0.01 (0.46)						
TAXR			0.08 (1.36)	0.03 (0.50)				
TR							-0.007 (0.86)	0.003 (0.29)

Values in parentheses are absolute values in z-score.

growth is reported to be positive but not significant, statistically speaking. The short-run (contemporaneous) effect of ODA on agricultural growth is not significantly different from zero. In the long run, however, a one percentage point increase in ODA will increase agricultural growth by 0.41 percentage points. Further breaking down the ODA by sector level does not significantly change the results. Net agricultural trade is also positively related to the growth of agriculture. It is because agricultural trade opens markets for agricultural products and further encourages agriculture growth by securing foreign exchange. The Terms of Trade (ToT), which is an index for the values of exports of a country relative to the values of imports, is also reported to be positively related to the growth of agriculture. That is, a ToT over 100 means the country is accumulating more money from exports than it is spending. Other macroeconomic policy variables were not significant, except for inflation. The results show that if inflation rises by 10 percentage points, agricultural growth will decline by 1.4 percentage points. Given that developing countries experience emigrations in huge numbers, a significant portion of the income in these countries is from remittance. I also added remittance (acquired from the World Bank) to the agricultural growth equation which was not statistically significant. However, adding remittance made the effect of ODA (in the long-run) significant.

3.2.3.2. Savings Equation

Overall the effect of all variables on savings is significant, except for agricultural growth, non-agricultural output growth, and tax revenue, which in this occasion were not statistically significant. As expected, agricultural trade significantly increases savings. This implies that agricultural trade helps in securing foreign exchange and thus increasing income per capita which in turn increases savings in less developed countries. Results strongly suggest that a 10 percentage point increase in agricultural trade will increase savings by 6.2 percentage points, *ceteris paribus*.

Furthermore, foreign direct investment and income per capita are also positively related to savings, suggesting that countries with higher income per capita and higher inflows of foreign investments tend to save more. The impact of ODA on savings is negative. Table 4 shows that a 10 percentage point increase in ODA will decrease savings by 6.7 percentage points. This is in line with previous research and our discussion of foreign aid and consumption in part 2.5., (Page 18). This result also supports the case of foreign aid critics who argue that official development assistance is mainly directed to consumption in less developed countries and therefore has no (or long-run negative) effect on economic growth. Results in table 4 also show that trade deficit negatively impacts savings. A one percentage point deficit in trade will cause savings to decline by approximately half. That is, the more a country relies on imports the less it saves.

3.2.3.3. ODA Equation

Table 4 shows that agricultural growth is positively related to ODA which implies that developing countries, where the main source of income is agriculture, receive more foreign aid. Agricultural imports have a positive effect on the flow of ODA into the developing countries, since poor countries spend a lot of their budget on food and as the food production in these countries is insufficient, main imports comprise agricultural goods. However, our results show that countries with more non-agricultural trade tend to receive less foreign aid. A reason for this might be that countries with more non-agricultural imports are relatively richer which means that the country is advanced enough to afford importing non-agricultural goods. Since poor countries with foreign exchange gap that hinder their ability to import capital goods are less likely to import non-agricultural goods (Chenery and Strout, 1966). Increased savings and higher level of income per capita tend to decline ODA since poor countries save less and saving is one of the characteristics that belong to the rich. This implies that ODA is mostly directed to poor countries. Finally, the impact of dependency ratio, which is one of the main characteristics of the

poor countries, is significantly and negatively related to ODA. That is, countries with higher non-productive population tend to have a lower income per capita and hence receive more of the ODA.

3.2.3.4. Agricultural Imports Equation

Variables in this equation are all positively related to agricultural imports, except for agricultural growth variable and inflation rate. The latter is not statistically significant either. The results show that, agricultural growth, *ceteris paribus*, is strongly and negatively related to agricultural imports. This is because agricultural growth leads to an increase in agricultural output that substitutes agricultural imports. The most important result in this equation, which is also the main thesis of this work, is the impact of ODA on agricultural imports. Breaking down ODA by sector level, our results in table 4 show that increasing non-agricultural ODA by 10 percentage points helps in increasing agricultural imports to the recipient country by 2.5 percentage points, supporting previous work on this topic (Kherallah et al., 1994; Norton and Pardey, 1992; Houck, 1998). ODA directly flowing to agriculture sector is much more effective. That is, 10 percentage points increase in agricultural ODA will increase agricultural imports by approximately 12 percentage points. This confirms that, *ceteris paribus*, official development assistance is positively related to agricultural imports in the recipient country. This increase in imports is because demand for imports grows faster than production (Pinstrup-Andersen et al., 1995). Furthermore, different countries have different comparative advantages in exports, depending on climate, which explains imports into developing countries. However, there is no guarantee that the imports will flow from the donor countries only. Furthermore, agricultural imports are also stimulated by increased income per capita in developing countries. That is, the richer the economy, the more they will import agricultural goods.

As stated before, given that developing countries experience emigrations in huge numbers, a significant portion of the income in these countries is from remittance. Adding remittance to the agricultural imports equation gives us interesting results. As you can see in table 5 that remittances significantly affects agricultural imports. Variables definition is given in appendix VII.

Table 5. Agricultural Imports with remittance

	Explanatory Variable						
	NAGODA	GRA	PCY	INF	TR	AGODA	REM
AgImports	0.1	-0.03	0.0001	0.02	-0.0009	-0.01	0.07
Absolute value in z-score	2.43	1.62	2.06	3.25	0.11	0.05	2.29

As you can see remittance significantly reduces the effect of agricultural ODA but does not affect non-agricultural ODA. Another variable that is interesting in table 5 is the positive and significant correlation of inflation with agricultural imports. An explanation for this could be that with domestic inflation general prices of agricultural goods rises and therefore encourages imports (Islam, 2013).

Chapter 4. Conclusion and Policy Implications

4.1. Thesis Summary

Majority of the developing countries are stuck in poverty trap. In other words, the normal economic cycle is broken. A normal economy follows a healthy cycle with rich household that saves what is left after paying taxes and other expenses. The government also invests, and saves what is left after paying for consumption on military and other non-productive sectors. Savings and investments lead to a higher capital accumulation which results in positive economic growth. Households, on the other end, benefit from the growth in overall economy and thus the virtuous cycle continues.

The problem with this cycle in poor and least developed countries is that the cycle starts with an impoverished household that has an income just enough to cover their basic needs. This household does not have enough surpluses to save and/or pay taxes to the government. Government, therefore, cannot contribute in investments and savings, which lead to a lower income per capita and a stagnant, or even negative, economic growth. This, in turn, adversely affects the household, making it more impoverished, and the vicious cycle continues.

Development economists believe that in order to bridge this gap, the industrialized world should help the developing countries break the poverty trap. This help should come in the form of foreign assistance—Official Development Assistance (ODA). Foreign aid will help government budget, investments, and households' income, which will lead in higher savings and higher income per capita. Some economists are optimistic that this help from outside will lead to a healthy economy that will start running on its own after a while.

Agriculture being the most important sector in these poor countries needs the most attention in this context. Majority of the population in developing countries are directly or indirectly

involved in agriculture. The impact of foreign aid on agricultural growth in developing countries is therefore an interesting topic. However, groups in developed countries are concerned about foreign aid adversely affecting their agricultural exports. They argue that foreign aid to developing countries will increase agricultural productivity in recipient countries which will reduce the demand for agricultural exports from the donor countries. In this thesis we applied a two stage least squares model with fixed effects to explore the links between agricultural growth, agricultural imports, savings, and ODA. Besides, we also looked at the impact of ODA (directly flowing into agriculture sector) on agricultural growth. Furthermore, we used deterministic simulation to analyze the impact of macroeconomic policy variables (i.e. trade, inflation, etc.) on agricultural growth, agricultural imports, savings, and ODA.

In a nutshell, the results suggest a positive relationship between agricultural growth and ODA, both contemporaneous and long-run. An important finding of this work is that ODA to developing countries increases these countries' demand for agricultural products. That is, official development assistance flow into developing countries helps increase income per capita and therefore leads to an increase in agricultural imports into the developing countries.

The long term solution for the developing world will involve trade, Foreign Direct Investment (FDI), microfinance, savings, and taxes—the instruments that the developed world uses to finance economic development and job creation (Moyo, 2009). Governments in developing countries can also simplify legal procedures and other policies to facilitate entry for new businesses and support both domestic and foreign investment. FDI will bring in new technologies and new managerial skills, and help in creating jobs and capacity building (Loungani and Razin, 2001). Innovations in microfinance to encourage small-scale entrepreneurs by providing support and opportunities can also help in economic growth (Moyo, 2009).

4.2. Policy Implications

Great care should be exercised in application of the results of this research. Lack of data on developing countries is an obstacle which does not allow researchers to come up with close to precise estimates. This work also suffered from lack of data on important variables necessary for better definition of model equations. However, all is not lost. With the results from the available data we still can draw useful policy implications.

As discussed in chapter two economists have two different stands when it comes to the impact of foreign aid on economic growth. First category believes that foreign aid has a positive impact on economic growth. In this thesis we also found that official development assistance is beneficial to both donors' economies—via expanding farm export markets—and to those of the recipients' economies—by improving agriculture—the main driver of growth. The second view is that foreign aid adversely affects economic growth in developing countries, unless good policies are followed. That is, good policies should be developed on both donor and recipient sides.

For foreign aid to solve current world problems in developing countries, a strong political will is required. Much of the literature suggests that economic and development objectives come in second to political objectives. This is one of the main reasons for the misallocation of foreign aid. Foreign aid works better in countries with good policies and institutions. Therefore donors should be more selective about the countries to which they provide aid.

Speaking of good policies, we now turn to another important topic which is conditionality. Donors believe that certain policies are good for growth in some countries. Therefore donors often apply conditions on aid programs to encourage the improvements of certain policies. As one can see this is a top-down approach. Instead, donors should ask developing countries to

come up with a set of policies which are applicable to their own environments, and they believe are better for their economies—a bottom up approach. Donors then can evaluate the proposed policies and either approve or reject those. This approach was used in Marshall Plan.

Many problems in developing countries are not very well defined to the tax payers in donor countries. That is, they have limited information about the problem indicators and success indicators—a principal-agent problem. Foreign aid is mostly wasted and sometimes misallocated because of this complex chain. Aid programs should be efficiently designed to shorten and simplify this long and complex chain of principal-agent relationship. Although this problem can never be fully solved, improvements can be made.

Empirical research on foreign aid suggests that multilateral aid is more effective than bilateral. That is, foreign aid via multilateral organizations such as the World Bank, IMF, UNDP, etc., has been more effective than bilateral aid. It is because, unlike multilateral aid, bilateral aid is mostly motivated by political objectives rather than economic and development objectives. Furthermore, aid flow from many different donors to a developing country is a problem for the recipient country, since different donors condition their aid on using different unique processes of initiating, implementing, monitoring and evaluating. For a better coordination and harmonization, pooling foreign aid through one of the major multilateral agencies can improve the effectiveness of aid.

Donors need to shift their approach to a results based management. This can happen when donors give most of the aid program ownership to the developing countries. Developing countries have the potential to define their problems, develop programs, and implement programs. By shifting ownership from donors to recipients, donors can then focus more on

monitoring and evaluation of their funds flow into the developing countries. By doing so, donors can stress on answering the ‘so what?’ question.

Agriculture, being a critical engine for the economic growth of developing countries, should be the primary target of investment in developing countries, since majority of the population are involved in this sector. Furthermore, agriculture in developing countries accounts for nearly half of gross domestic product, and more than half of export earnings (Pinstrup-Andersen et al., 1995). Although cutting foreign aid will retard economic growth and social development, exacerbate poverty, increase food insecurity, increase instability, and increase health and mortality risks in developing countries, donors evaluate their foreign aid based on their national interests. Foreign assistance to agriculture declined in late 20th century primarily because farm groups in donor countries believed that agricultural assistance to developing countries will take away their export markets.

Our results in this thesis, although counterintuitive, suggest that increasing agricultural assistance to developing countries will actually increase imports into developing countries. The intuition behind this is that assistance to agricultural research in developing countries will increase agricultural production which in turn boosts income. People in developing countries then bring changes in their diets and hence demand for goods and services increases. Economic growth in developing countries follows subsequently which leads to more imports. This is in line with previous research. According to a report by The International Food Policy Research Institute (IFPRI), \$1 assistance to agricultural research in developing countries will increase imports by \$4.39 by these countries, and the same dollar will increase agricultural imports by \$1.06 and cereal imports by \$0.45 (Pinstrup-Andersen et al., 1995). However, by adding remittance into agricultural imports equation we defy the above results. As remittance accounts

for significant amount of income in developing countries, therefore it is a significant variable in determining agricultural imports into these countries.

Having said that, we conclude that to alleviate poverty and help developing countries take their first step towards development, diverting ODA to agriculture sector can be an intelligent move, as currently a very insignificant amount of ODA is directed into agriculture sector.

4.3. Limitations and Ideas for Further Research

One of the limitations of this study includes lack of data on important variables for developing countries. The data available on developing countries is limited. For example, tax revenues and agricultural research data is missing for majority of the developing countries. Furthermore, data on annual precipitation is not available for most of the developing countries. The list goes on. Lack of these variables is a limitation in identifying and measuring the determinants of agricultural income growth and other model equations. The quality of data is also questionable, as different sources provide different data sets on a specific variable.

Taking the discussion into farm level can be a good area for future research. Analyzing the impact of foreign aid on individual country agriculture on farm level, with a longer time span, and with different methodology might better explore the relationship between agricultural growth and foreign aid.

References

- Aksoy, M. A. (2005). Global agricultural trade policies. *M. Ataman Aksoy and John C. Beghin*, 37.
- Bachman, K. L. (1965). Agricultural Economics and Technical Aid in Foreign Development. *Journal of Farm Economics*, 47(5), 1079-1090.
- Bachman, K. L., & Paulino, L. A. (1979). *Rapid food production growth in selected developing countries: a comparative analysis of underlying trends, 1961-76* (Vol. 11). Intl Food Policy Res Inst.
- Barro, R., & Sala-i-Martin, X. (2004), *Economic Growth*, MIT press.
- Board of Governors of the Federal Reserve System (U.S.) , 1935- and Federal Reserve Board , 1914-1935. "September 1940," *Federal Reserve Bulletin* (September, 1940).https://fraser.stlouisfed.org/scribd/?item_id=21029&filepath=/files/docs/publications/FRB/1940s/frb_091940.pdf, accessed on February 9, 2017.
- Boone, P. (1996). Politics and the effectiveness of foreign aid. *European economic review*, 40(2), 289-329.
- Burnside, A. C., & Dollar, D. (1997). Aid, policies, and growth.
- Chenery, H. B., & Strout, A. M. (1966). Foreign assistance and economic development. *The American Economic Review*, 679-733.
- Collier, P. (2007). Bottom billion. *The Wiley-Blackwell Encyclopedia of Globalization*.
- De Janvry, A., & Sadoulet, E. (1988). The conditions for compatibility between aid and trade in agriculture. *Economic Development and Cultural Change*, 37(1), 1-30.
- Dhar, B., & Roy, S. S. (1996). Foreign Direct Investment and Domestic Savings-Investment Behaviour: Developing Countries' Experience. *Economic and Political Weekly*, 2547-2551.
- Easterly, W., & Easterly, W. R. (2006). *The white man's burden: why the West's efforts to aid the rest have done so much ill and so little good*. Penguin.
- Erixon, F. (2006), *More aid is not the answer*, <http://europesworld.org/2006/06/01/more-aid-is-not-the-answer/#.WJ0q1G8rKCg>
- Faostat, F. A. O. (2016). Statistical databases. *Food and Agriculture Organization of the United Nations, Rome*.
- Fischer, S. (1993). The role of macroeconomic factors in growth. *Journal of monetary economics*, 32(3), 485-512.

- Gollin, D., Parente, S., & Rogerson, R. (2002). The role of agriculture in development. *American Economic Review*, 160-164.
- Griffin, K. (1978). Foreign capital, domestic savings and economic development. In *International Inequality and National Poverty* (pp. 57-80). Palgrave Macmillan UK.
- Griffin, K. B., & Enos, J. L. (1970). Foreign assistance: objectives and consequences. *Economic development and cultural change*, 18(3), 313-327.
- Griffin, K. B., & Enos, J. L. (1970). Foreign assistance: objectives and consequences. *Economic development and cultural change*, 18(3), 313-327.
- Gupta, K. L., & Islam, M. A. (1983). foreign Capital. *Savings and Growth*.
- Houck, J. P. (1988). Link between agricultural assistance and international trade. *Agricultural Economics*, 2(2), 159-166.
- Hoy, M., Livernois, J., McKenna, C., Rees, R., & Stengos, T. (2011). *Mathematics for economics*. MIT press.
- Integrity, G. F. (2015). Financial Flows and Tax Havens.
- International Monetary Fund (IMF), International Financial Statistics, accessed at: <http://stats.ukdataservice.ac.uk/>
- Islam, M. A. (2013). Impact of inflation on import: An empirical study. *International Journal of Economics, Finance and Management Sciences*, 1(6), 299-309.
- Johnston, B. F., & Mellor, J. W. (1961). The role of agriculture in economic development. *The American Economic Review*, 51(4), 566-593.
- Kherallah, M. W., Beghin, J. C., Peterson, E. W. F., & Ruppel, F. J. (1994). Impacts of official development assistance on agricultural growth, savings and agricultural imports. *Agricultural Economics*, 11(2-3), 99-110.
- Loungani, P., & Razin, A. (2001). How beneficial is foreign direct investment for developing countries?. *Finance and Development*, 38(2), 6-9.
- Meijerink, G. W., & Roza, P. (2007). *The role of agriculture in economic development* (No. 4). Wageningen UR.
- Miguel Lebre de Freitas, 2014, *IntroductIon to economic growth*, mimeo, <https://mlebredefreitas.wordpress.com/teaching-materials/economic-growth-models-a-primer/>
- Mikesell, R. F. (1970). *The economics of foreign aid*. Transaction Publishers.

- Mikesell, R. F., & Zinser, J. E. (1973). The nature of the savings function in developing countries: a survey of the theoretical and empirical literature. *Journal of Economic Literature*, 11(1), 1-26.
- Mosley, P., Hudson, J., & Horrell, S. (1987). Aid, the public sector and the market in less developed countries. *The Economic Journal*, 97(387), 616-641.
- Moyo, D. (2009). *Dead aid: Why aid is not working and how there is a better way for Africa*. Macmillan.
- Norton, G. W., Ortiz, J., & Pardey, P. G. (1992). The impact of foreign assistance on agricultural growth. *Economic Development and Cultural Change*, 40(4), 775-786.
- Papanek, G. F. (1972). The effect of aid and other resource transfers on savings and growth in less developed countries. *The Economic Journal*, 82(327), 934-950.
- Papanek, G. F. (1973). Aid, foreign private investment, savings, and growth in less developed countries. *Journal of political Economy*, 81(1), 120-130.
- Pinstrup-Andersen, P., Lundberg, M., & Garrett, J. L. (1995). Foreign assistance to agriculture: A win-win proposition.
- Praduma, B. R., & Dowling Jr, J. M. (1988). The Impact of Foreign Capital and Growth: Evidences From Asian Developing Countries. *The Developing Economies*, 26(1).
- Radelet, S. (2006). A primer on foreign aid. Center for Global Development working paper, 92.
- Rahman, M. A. (1967). The welfare economics of foreign aid. *The Pakistan Development Review*, 7(2), 141-159.
- Romer, D. (1996). *Advanced macroeconomics*. mcgraw-hill companies.
- Sachs, J. (2006). *The end of poverty: economic possibilities for our time*. Penguin.
- Schuh, G. E., Kellogg, E. D., & Paarlberg, R. L. (1987). Assistance to developing country agriculture and US agricultural exports: Three perspectives on the current debate.
- Timmer, C. P. (1988). The agricultural transformation. *Handbook of development economics*, 1, 275-331.
- Tomek, W. G. (1993). Confirmation and replication in empirical econometrics: A step toward improved scholarship. *Amer. J. Agr. Econ*, 75, 6-14.
- Towards the end of poverty. (2013, June 1). *The Economist*, accessed at: <http://www.economist.com/news/leaders/21578665-nearly-1-billion-people-have-been-taken-out-extreme-poverty-20-years-world-should-aim>
- World Bank. (2007). *World development report 2008: Agriculture for development*. World Bank.

Appendices

Appendix I

Step by step derivation of the capital accumulation and Euler's equations.

$$\text{maximize } U = \int_0^{\infty} u(\hat{c}(t)A(t))e^{nt}e^{-\rho t}dt$$

$$S. t. \quad \dot{\hat{k}}(t) = \hat{y}(t) + \widehat{ODA} - \hat{c}(t) - (\delta + n + x)\hat{k}(t)$$

$$\mathcal{H} = u(\hat{c}A)e^{-(\rho-n)t} + \hat{\lambda}(\hat{y} + \widehat{a}id - \hat{c} - (\delta + n + x)\hat{k})$$

The first part of the Hamiltonian equation represents current benefit from consumption and the second part shows future benefit from investment (i.e., it shows utility from having more capital tomorrow). Considering the fact that $A(t) = A(0)e^{xt}$, and $A(0) = 1$, I differentiate the above equation.

$$1. \quad \frac{\partial \mathcal{H}}{\partial \hat{c}} = 0 \quad u' e^{-(\rho-n-x)t} = \hat{\lambda}$$

Where the left hand-side is the marginal benefit and right hand-side is marginal cost.

$$2. \quad -\frac{\partial \mathcal{H}}{\partial \hat{k}} = \dot{\hat{\lambda}} \quad -\hat{\lambda}(r - \delta - n - x) = \dot{\hat{\lambda}}$$

$$3. \quad \frac{\partial \mathcal{H}}{\partial \hat{\lambda}} = \dot{\hat{k}} \quad \dot{\hat{k}} = \hat{y} + \widehat{ODA} - \hat{c} - (\delta + n + x)\hat{k}$$

In the above equations, $\hat{\lambda}$ is the shadow value (price). This is similar to Lagrange multiplier, except here it is dependent on time (I dropped the t letter for time from the above equations for the sake of simplicity in derivations).

Differentiating 1 with respect to time:

A.

$$\dot{\hat{\lambda}} = \dot{c} \cdot u''(c) e^{-(\rho-n-x)t} + u' e^{-(\rho-n-x)t} (-(\rho - n - x))$$

$$\dot{\hat{\lambda}} = \frac{\hat{\lambda}}{u'} \dot{c} u'' + \hat{\lambda} (-(\rho - n - x))$$

$$\frac{\dot{\hat{\lambda}}}{\hat{\lambda}} = \dot{c} u''/u' - (\rho - n - x)$$

B. Dividing 2 by $\hat{\lambda}$.

$$\frac{\dot{\hat{\lambda}}}{\hat{\lambda}} = -r + \delta + n + x$$

Setting equations A and B equal to each other, I have:

$$\dot{c}u''/u' - (\rho - n - x) = -r + \delta + n + x$$

$$\dot{c}u''/u' = -r + \delta + \rho$$

$$-\frac{\dot{c}}{c}u''/u' c = r - \delta - \rho$$

Since $-\frac{u''}{u'}c =$ relative risk aversion, we show it in Θ

Therefore:

$$\frac{\dot{c}}{c} = \frac{r - \delta - \rho}{\Theta}$$

And since $\frac{\dot{c}}{\hat{c}} = \frac{\dot{c}}{c} - \frac{\dot{A}}{A}$, and $\frac{\dot{A}}{A} = x$, we have:

$$\frac{\dot{\hat{c}}}{\hat{c}} = r - \delta - \rho - x\Theta$$

This, above, is Euler's equation.

Finally, we write our resource constraint equation again which we derived earlier in step 3.

$$\dot{\hat{k}} = \hat{y} + \widehat{ODA} - \hat{c} - (\delta + n + x)\hat{k}$$

For the technical assistance, where foreign aid enters into both equations above in the form

of $\hat{y} = \widehat{aid} * \hat{k}^\alpha$, therefore, it affects r and $\hat{y}$ in the above equations. Because $r = f'(\hat{y})$.

Appendix II

Deriving reduced form of equations.

Agricultural growth equation:

$$GRA = f\left(\sum_{j=-1}^6 \beta_j ODA_{t-j}, SAV, FPI, AGTR\right)$$

Savings equation:

$$SAV = f(GRA, ODA, FPI, PCY, AGTR, NAGTR, TAXR)$$

Official development assistance equation:

$$ODA = f(GRA, SAV, AGIMP, PCY, GRNA)$$

Agricultural imports equation:

$$AGIMP = f(GRA, ODA, PCY, FEL)$$

I transform the equations into elasticity forms by totally differentiating each equation with respect to the relevant dependent variable, I have:

For the sake of simplicity in GRA equation, I write ODA instead of $\sum_{j=-1}^6 \beta_j ODA_{t-j}$.

$$\begin{aligned} \frac{dGRA}{GRA} &= \left(\frac{\partial GRA}{\partial SAV} \frac{SAV}{GRA}\right) \frac{dSAV}{SAV} + \left(\frac{\partial GRA}{\partial ODA} \frac{ODA}{GRA}\right) \frac{dODA}{ODA} + \left(\frac{\partial GRA}{\partial FPI} \frac{FPI}{GRA}\right) \frac{dFPI}{FPI} \\ &\quad + \left(\frac{\partial GRA}{\partial AGTR} \frac{AGTR}{GRA}\right) \frac{dAGTR}{AGTR} \end{aligned}$$

$$\begin{aligned}\frac{dSAV}{SAV} &= \left(\frac{\partial SAV}{\partial GRA} \frac{GRA}{SAV}\right) \frac{dGRA}{GRA} + \left(\frac{\partial SAV}{\partial ODA} \frac{ODA}{SAV}\right) \frac{dODA}{ODA} + \left(\frac{\partial SAV}{\partial FPI} \frac{FPI}{SAV}\right) \frac{dFPI}{FPI} \\ &\quad + \left(\frac{\partial SAV}{\partial PCY} \frac{PCY}{SAV}\right) \frac{dPCY}{PCY} + \left(\frac{\partial SAV}{\partial AGTR} \frac{AGTR}{SAV}\right) \frac{dAGTR}{AGTR} \\ &\quad + \left(\frac{\partial SAV}{\partial NAGTR} \frac{NAGTRD}{SAV}\right) \frac{dNAGTR}{NAGTR} + \left(\frac{\partial SAV}{\partial TAXR} \frac{TAXR}{SAV}\right) \frac{dTAXR}{TAXR}\end{aligned}$$

$$\begin{aligned}\frac{dODA}{ODA} &= \left(\frac{\partial ODA}{\partial GRA} \frac{GRA}{ODA}\right) \frac{dGRA}{GRA} + \left(\frac{\partial ODA}{\partial SAV} \frac{SAV}{ODA}\right) \frac{dSAV}{SAV} \\ &\quad + \left(\frac{\partial ODA}{\partial AGIMP} \frac{AGIMP}{ODA}\right) \frac{dAGIMP}{AGIMP} + \left(\frac{\partial ODA}{\partial PCY} \frac{PCY}{ODA}\right) \frac{dPCY}{PCY} \\ &\quad + \left(\frac{\partial ODA}{\partial GRNA} \frac{GRNA}{ODA}\right) \frac{dGRNA}{GRNA}\end{aligned}$$

$$\begin{aligned}\frac{dAGIMP}{AGIMP} &= \left(\frac{\partial AGIMP}{\partial GRA} \frac{SAV}{AGIMP}\right) \frac{dSAV}{SAV} + \left(\frac{\partial AGIMP}{\partial ODA} \frac{ODA}{AGIMP}\right) \frac{dODA}{ODA} \\ &\quad + \left(\frac{\partial AGIMP}{\partial PCY} \frac{PCY}{AGIMP}\right) \frac{dPCY}{PCY} + \left(\frac{\partial AGIMP}{\partial FEL} \frac{FEL}{AGIMP}\right) \frac{dFEL}{FEL}\end{aligned}$$

$$GRA^* = \varepsilon SAV^* + \varepsilon_1 \sum_{j=-1}^6 \beta_j ODA_{t-j}^* + \varepsilon_2 FPI^* + \varepsilon_3 AGTR^*$$

$$\begin{aligned}SAV^* &= \varepsilon_4 GRA^* + \varepsilon_5 ODA^* + \varepsilon_6 FPI^* + \varepsilon_7 PCY^* + \varepsilon_8 AGTR^* + \varepsilon_9 NAGTRD^* \\ &\quad + \varepsilon_{10} TAXR^*\end{aligned}$$

$$ODA^* = \varepsilon_{11} GRA^* + \varepsilon_{12} SAV^* + \varepsilon_{13} AGIMP^* + \varepsilon_{14} PCY^* + \varepsilon_{15} GRNA^*$$

$$AGIMP^* = \varepsilon_{16} GRA^* + \varepsilon_{17} ODA^* + \varepsilon_{18} PCY^* + \varepsilon_{19} FEL^*$$

Appendix III

List of countries covered in sample.

Algeria	Kenya
Argentina	Malawi
Bangladesh	Malaysia
Bolivia	Mauritania
Brazil	Mexico
Cameroon	Morocco
Central African Republic	Nicaragua
Colombia	Pakistan
Congo	Panama
Costa Rica	Paraguay
Ivory Coast	Peru
Dem. Rep. Congo	Philippines
Dominican Republic	Rwanda
Ecuador	Senegal
Egypt	Sierra Leone
El Salvador	Sri Lanka
Ghana	Tanzania
Guatemala	Thailand
Honduras	Tunisia
India	Turkey
Indonesia	Uruguay
Jamaica	Zambia
Jordan	Zimbabwe

Appendix IV

Quadratic Distribution-Lag of ODA

Following Parker (2013)¹⁹ I use quadratic distributed-lag for the ODA variable to restrict the lag coefficient to lie on parabola.

$$\beta_s = \alpha_0 + \alpha_1 s + \alpha_2 s^2, \quad s = 0, 1, \dots, 6.$$

Where α_0, α_1 , and α_2 are the parameters of the quadratic function describing the lag weights.

$$GRA_t = \xi + \sum_{s=-1}^6 (\alpha_0 + \alpha_1 s + \alpha_2 s^2) ODA_{t-s} + \epsilon_t^{20}$$

$$GRA_t = \xi + \alpha_0 \sum_{s=-1}^6 ODA_{t-s} + \alpha_1 \sum_{s=-1}^6 s ODA_{t-s} + \alpha_2 \sum_{s=-1}^6 s^2 ODA_{t-s} + \epsilon_t$$

Or

$$GRA_t = \xi + \alpha_0 Z_t^0 + \alpha_1 Z_t^1 + \alpha_2 Z_t^2 + \epsilon_t$$

Where

$$Z_t^0 \equiv \sum_{s=-1}^6 ODA_{t-s}, \quad Z_t^1 \equiv \sum_{s=-1}^6 s ODA_{t-s}, \quad Z_t^2 \equiv \sum_{s=-1}^6 s^2 ODA_{t-s}$$

Applying restriction where we assume that $\beta_{-1} = \beta_6 = 0$, we have final equation to estimate:

$$GRA_t = \xi + \alpha_2 (-6Z_t^0 - 5Z_t^1 + Z_t^2), \quad \text{Since } \alpha_0 = -6\alpha_2 \text{ and } \alpha_1 = -5\alpha_2$$

¹⁹ Unpublished class notes.

²⁰ ϵ includes all other dependent variables used in the agricultural growth equation. For the sake of simplicity those are not reported in this appendix.

Plugging $\hat{\alpha}_2$ back in $\beta_s = \alpha_0 + \alpha_1 s + \alpha_2 s^2$ we calculate the estimated values of β for each period. Summing all β_s we have the effect of ODA on agricultural growth in the long run which is reported as $\sum_{s=0}^6 \beta_s ODA_{t-s}$, in table 4.

Appendix V

Estimates from the original paper along with mean of variables used for acquiring elasticities (by Kherallah et al., 1994)

Definition	Value ^a	Variable	Mean
Impact of saving on agricultural growth	0.21	GRA	2.16
Impact of ODA on agricultural growth	0.006	GRNA	3.07
Impact of foreign private investments on agricultural growth	-0.41	SAV	15.85
Impact of agricultural trade on agricultural growth	0.11	ODA	5.28
Impact of agricultural growth on savings	0.14	AGIMP	4.37
Impact of ODA on savings	-0.72	NAGIMP	23.16
Impact of foreign private investments on savings	0.9	LagODA	262.96
Impact of income per capita on savings	0.003	FPI	0.84
Impact of agricultural trade on savings	0.26	AGTR	2.5
Impact of non-agricultural trade deficit on savings	-0.27	NAGTRD	8.42
Impact of tax revenues on savings	0.28	TOT	95.39
Impact of agricultural growth on ODA	0.03	OVER	90.15
Impact of savings on ODA	-0.25	DEF	-5.36
Impact of agricultural imports on ODA	0.99	ARES	0.2
Impact of income per capita on ODA	-0.002	INF	93.09
Impact of non-agricultural growth on ODA	0.1	PCY	899.1
Impact of agricultural growth on agricultural imports	-0.04	DR	45.6
Impact of ODA on agricultural imports	0.41	TAXR	15.91
Impact of income per capita on agricultural imports	0.001	FEL	7.31
Impact of foreign exchange holdings on agricultural imports	0.14		

Appendix VI

List of data sources

Variable	Definition	Source
GRA	agricultural growth rate	World Bank
GRNA	official development assistance	World Bank
INF	gross domestic savigs	World bank
AGTR	net agricultural exports	calculated by author
AGIMP	agricultural imports	FAO
AGEXP	agricultural exports	FAO
FDI	foreing direct investment	World Bank
ODA	non-agricultural growth rate	OECD
AGODA	ODA to agriculture	OECD
NAGEXP	non-agricultural exports	World Bank
NAGIMP	non-agricultulra imports	World Bank
NAGTRD	non-agricultural trade deficit	calculated by author
SAV	inflation rate, consumer price	World Bank
TAXR	tax revenue	World Bank, IMF, AfDB
PCY	income per capita, constant 2010 US dollar	World Bank
TR	total reserve	World Bank
DR	dependency ratio [$(<15 + >64)/15-64$]	World Bank
ARE	agricultural research spendings	ASTI ^a
TOT	terms of trade	World Bank

^a Aricultural science and technology spendings

Data Summary

Treated as	Variable	Definition	Unit	Observations	Mean	St. Dev.	Min	Max
Endogenous	GRA	agricultural growth rate	% change	598	3.260806	6.495362	-39.3	41.168
Exogenous	GRNA	non-agricultural growth rate	% change	598	4.831035	4.577925	-28.286	35.329
Exogenous	INF	inflation rate, consumer price	% change	598	6.883594	10.33025	-72.729	156.964
Exogenous	AGTR	agricultural trade (exports-imports)	% of GDP	598	0.7297291	5.305212	-17.362	20.563
Endogenous	AGIMP	agricultural imports	% of GDP	598	4.257488	2.97609	0.333	19.506
Endogenous	AGEXP	agricultural exports	% of GDP	598	4.987192	4.758818	0.07	26.025
Exogenous	FDI	foreign direct investment	% of GDP	598	3.762876	4.489238	-2.499	38.81
Endogenous	ODA	official development assistance	% of GDP	598	4.142391	6.250847	-0.643	60.593
Endogenous	NAGODA	non-agricultural ODA	% of GDP	598	3.919605	6.026587	-0.667	60.52
Exogenous	AgODA	ODA to agriculture	% of GDP	598	0.2227926	0.3622324	0	2.193
Exogenous	NAGEXP	non-agricultural exports	% of GDP	598	28.50068	17.70478	3.294	106.653
Exogenous	NAGIMP	non-agricultural imports	% of GDP	598	35.3422	16.26709	10.462	90.327
Exogenous	NAGTRD	non-agricultural trade deficit	% of GDP	598	6.841502	11.44194	-44.498	34.654
Endogenous	SAV	gross domestic savings	% of GDP	598	16.70597	12.86654	-21.46	57.062
Exogenous	TAXR	tax revenue	% of GDP	598	15.89005	6.117419	2.5	45.253
Exogenous	REM	remittance	% of GDP	558	4.600964	5.221053	0	22.285
Exogenous	PCY	income per capita, constant 2010 US dollar	\$/person	598	3478.371	3069.428	257.114	13856.89
Exogenous	TR	total reserve	% of GDP	598	16.7375	14.55823	0.405	113.139
Exogenous	DR	dependency ratio [(<15 + >64)/15-64]	% of working population	598	67.66449	15.95834	38.815	99.659
Exogenous	TOT	terms of trade	unitless	598	111.4939	34.88559	48.916	290.904